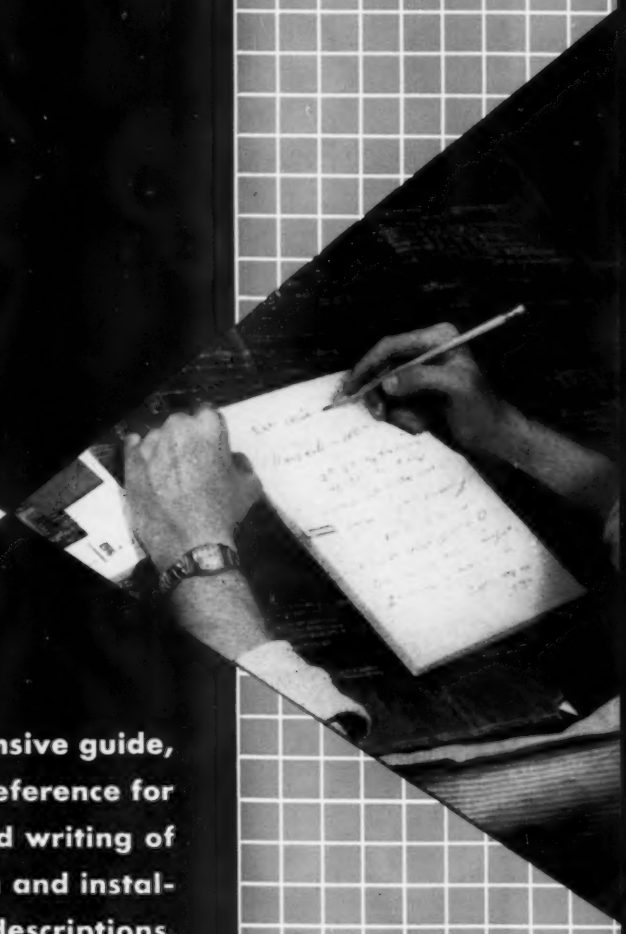
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Electrical Construction and Maintenance

WITH ELECTRICAL CONTRACTING



Electrical Specifications

A comprehensive guide, prototype and reference for the preparation and writing of electrical construction and installation specifications, job descriptions, and recommendations. Complete in this issue.

McGRAW-HILL PUBLICATION | 57TH YEAR


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4-foot or 8-foot lengths
Sides: L. W. with Light Windows, or S. S. with Solid Sides
GrateLite louver diffuser, metal cross baffles, or Pattern #70 low brightness lens.
WRITE TODAY FOR ALL DETAILS
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ST. LOUIS 3, MO.
TRUSTED NAME IN LIGHTING SINCE 1902

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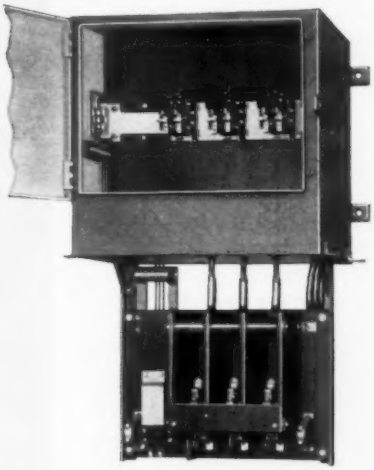
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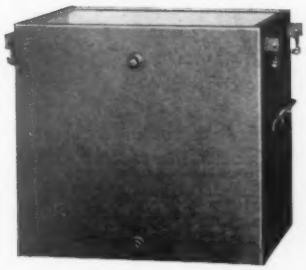


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Published for electrical contractors, electrical departments in industry, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

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Sidelights 5

Washington Report 7

To Specify Quality, *An Editorial* 71

Electrical Specifications 73

A master specification for electrical construction and installation designed for use as a guide, or reference in the preparation of project specifications, job descriptions, recommendations and proposals.

- General Conditions 74
- Service Entrances 78
- Transformers 82
- Circuit Switching and Protection 85
- Feeders 89
- Branch Circuits 97
- Lighting 109
- Motors, Generators and Controls 117
- Air Conditioning and Heating 122
- Residential Wiring Specifications 128
- Signal, Communications and Auxiliary Systems ... 134

Reader Service 297

Product news announcements, catalogs and bulletins.

Reader's Quiz 305

Questions and answers on fluorescent color correction; lv-dc generator; amplidynes; drying ignition transformers.

Questions on the Code 311

Answers to code questions including motor-feeder overcurrent protection; transformer bank; service condulets.

Motor Shops 319

Rolling grate and guides facilitate coil burning; compression baler for copper salvage; split-phase coil jumpers reduced by spring holder.

In the News 323

Dates Ahead 329

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Engineered for Dependability

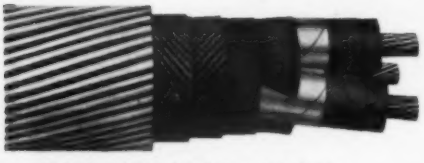
. . . in Mining and Quarrying



Tirex Shuttle Car Cable

Mining engineers everywhere who insist on first line quality are careful to specify Simplex-TIREX heavy-duty cables. The durability for which TIREX is famous results from curing and conditioning advanced compounds in a lead mold. This process, originated by Simplex in 1920, has never been surpassed.

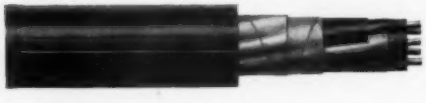
. . . in Power and Lighting



Anhydrex Insulated Submarine Cable

Simplex-ANHYDREX and ANHYDREX XX Insulated cables are designed for installation in any environment. They operate dependably in circuits requiring up to 35 Kv; permit conductor temperatures as high as 90°C. wet or dry; and can be supplied with any desired outer covering, round wire armor, C-L-X continuous metal sheath and Simplex Condex interlocked armor.

. . . in Railroading



Railroad Signal Cable

Railroad men rely heavily on Simplex cable for every wiring application, including Power, Control, Communication, Signal, Diesel Wire, Car Wire, and portables. This is especially true where Signal Cable is concerned. Their sense of responsibility both to the road and to the public demands that they use only the finest.

NEW C-L-X

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C-L-X Sheath with Thermoplastic Cover

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LIVE BETTER ELECTRICALLY

Sidelights

MASTER ELECTRICAL SPECIFICATION

Most of the editorial contents of this issue is devoted to one of our largest and most comprehensive continuing editorial projects—a master electrical specification. This edition, nearly eight months in preparation, has been extensively revised and brought up-to-date since the last revision in May 1955. An important new feature has been added. At the beginning of each section, a check list is provided which in addition to giving a quick summary of the contents, of the section, can be used as a reminder list or check-out for any specification or job description to insure that it covers all of the desired details.

NEW SERVICE REQUIREMENTS

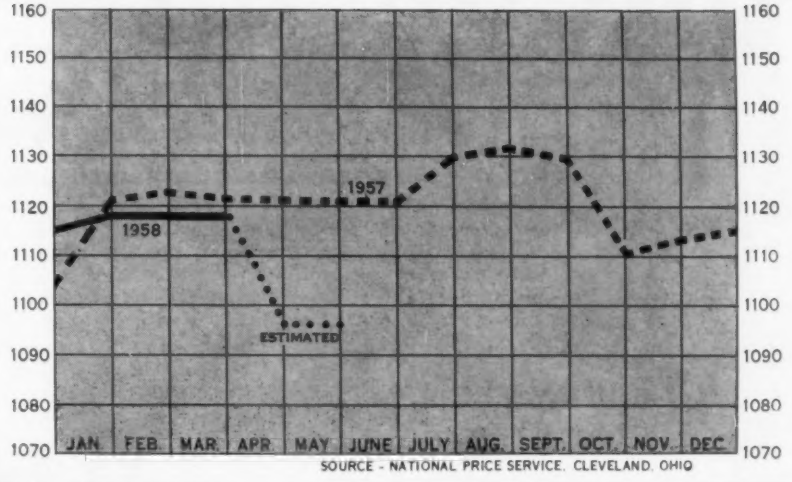
New regulations affecting the installation of high capacity (1200-amp and over) secondary services in the City of New York are expected to be issued by the City's Department of Water Supply, Gas and Electricity this month. Several recent disastrous accidents have brought about a critical re-examination of design and installation practice. The new rules, which will become mandatory in the area under the Department's jurisdiction, will influence design in other cities with similar high-capacity secondary service installations. Some of the new rules are expected to include high-interrupting-capacity short circuit protection at the point of entrance, remote control of service switches capable of being safely operated under full load and low-impedance grounding conductors to insure operation of overcurrent devices under phase-to-ground faults. Engineering Editor J. F. McPartland, Jr. will have a complete report for our readers on this important development as soon as the full text of the regulations is available.

PERFORATED PAGES

Many of our readers have suggested changes in the arrangement of our "Questions on the Code" and "Reader's Quiz" departments to simplify removal and filing. If you haven't noticed, since the March issue this year, we have incorporated the two items most persistently requested; editorial matter on one side of the page only, and perforation of the pages in the gutter to facilitate easy removal. We hope that the new features will give added convenience to the use of these popular departments and expedite filing for future reference. At this time only one "form" is perforated. We shall appreciate comments from our readers as to whether they would like other editorial departments to be given similar treatment.

ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



SOURCE - NATIONAL PRICE SERVICE, CLEVELAND, OHIO



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GARFIELD, NEW JERSEY

Washington Report

● **The recession slump is slowly losing its steam,** as is being indicated daily by many business indices as they are released. President Eisenhower refused to be panicked into approval of the batch of election-year costly anti-recession schemes proposed by Congress, took instead a saner look ahead for a sounder economic and business future.

Common denominator for Congressional accomplishments this year is—**Spend.** Generally dubbed as anti-recession measures (although indications are that business will level out and turn up again before bills passed by Congress would provide any relief) some typical bills passed by Congress are:

—New $1.9 billion housing bill. (Passed by Pres. Eisenhower, who criticised its anti-recession features).
—Bill to freeze farm price supports for one year (vetoed).
—New $5.5 billion highway construction bill, which would add $1.8 billion to previous plans.
—$1.5 billion river and harbor projects bill (vetoed).
—$1.3 billion increase in defense spending (by June 30).

● **New construction spending in March totaled $3.4 billion,** up from $3.3 billion a year earlier. For the 1st Quarter, the $9.7 billion total was up 3% from the like 1957 period. Private construction was up 1%, while public expenditures increased 7%.

New housing starts in March totaled 79,000, 9% below March 1957. Adverse weather was blamed for the low figure. Totals for the 1st Quarter were 213,000, down from 217,000 starts in the like period of last year.

● **Electric power output has been lagging year earlier records** by an average of 2% to 3%, based on reported weekly totals. Output has been averaging 11.3 to 11.6 billion kwhr weekly through March and April, but soared to weekly records last year in excess of 12 billion kwhr. Biggest decline has been in the Central Industrial geographic region.

● **Electrical manufacturing costs are bumped up again** as more than a million workers under long-term automatic wage increase contracts get increases as a result of the new record-high level of 123.3% (of the 1947-49 average) for the cost-of-living reported by BLS for March. All told, BLS estimates more than four million workers will get these automatic raises this year. The CL Index in March 1957 was 118.9; in March 1948 (ten years ago) 102.8.

● **Cautious optimism is being reflected by some Government officials** as signs of a "leveling out" show up in the economy. Here are some highlights of the factors being watched closely by the Administration in its "wait and see" approach: Gross National Product for 1st Quarter was $424 billion annual rate—down $16 billion from last year's record 3rd Quarter $440 billion annual rate; Industrial production in March slipped to 128% of 1947-49 average—a 14% decline from all-time high reached in December 1956; Personal income in March was at annual rate of $341.4 billion—record high was $347.3 billion rate in August 1957; Employment rose 323,000 in March to 62,311,000 total—only 2.5% below March 1957 figure; Unemployment in March increased 25,000, to 5,198,000; Retail sales in March totaled $15.4 billion—a drop of $400 million from March 1957; Steel production during April was down to about 79% of the 1947-49 average, or at less than 50% of 1958 capacity, but was beginning to show signs of seasonal improvement.

REGULAR



7311
3-wire Armored Cap

20 amps., 250 V. A.C. or D.C.
10 amps., 600 V. A.C.



7313
3-wire Connector Body

"INSULPRENE"



9770
2-wire Cap

20 amps., 250 V. A.C. or D.C.



Resistant to oil, water or impact

9768
2-wire Connector Body

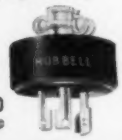
GROUNDING



4700
Duplex Receptacle

15 amps., 125 volts

For grounding purposes only



4720
3-wire Rubber Cap

SUPER



3221
2-wire Armored Cap

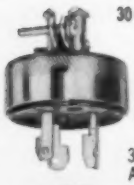
20 amps., 250 volts



Screwless terminals and dead front

3223
2-wire Connector Body

30 AMP. SUPER



3331
3-wire Armored Cap

30 amps., 250 V. A.C. or D.C.



3333
3-wire Connector Body

MIDGET



7464
2-wire Connector Body



7465
2-wire Cap

10 amps., 250 volts
15 amps., 125 volts



7466
2-wire Male Flush Base

It Pays To Have Good Connections

For over 70 years, Hubbell specification grade wiring devices have been recognized for their dependability, trouble-free operation and quality appearance. And there are other reasons, too, why it is good business to specify Hubbell. For example:

Hubbell devices incorporate carefully engineered installation advantages which save you time, trouble and expense.

Hubbell devices are always readily available—sold exclusively through authorized electrical distributors who are supplied from strategically located warehouses throughout the country.

Hubbell devices are nationally advertised and merchandised to support your selling efforts.

Hubbell devices are backed by field engineering to assist you in any phase of your electrical installation.

The products shown are representative of Hubbell's complete line of quality wiring devices. For full information, write Harvey Hubbell, Inc., Bridgeport, Conn., or contact your nearest distributor.

Heavy-duty, dust-tight, locking connectors



30 amps., 600 V. A.C.
20 amps., 250 V. D.C.

20403
4-wire Receptacle with 20416 lift cover plate



20415
4-wire Male Cap



30 amps., 600 V. A.C.
20 amps., 250 V. D.C.

20414
4-wire Connector Body



5262
Duplex Receptacle

15 amps., 125 volts

For grounding portable elec. equip.

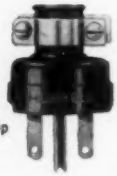


5264
Armored Cap



5661
Single Receptacle

15 amps., 250 volts



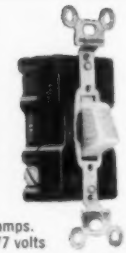
5676
Rubber Cap

Withstand Inductive Fluorescent Loads



15 amps.
120-277 volts

Topper **1201**
Single Pole A.C. Toggle Switch



15 amps.
120-277 volts

pressSwitch **1251-I**
Single Pole press-action A.C. Switch

(ADVERTISEMENT)

Electrical Contractors Report:

"HOUSEPOWER Means Quality— and Quality Means Profits...



Saville

. . . profits in time and money," declares W. C. Saville, of Belvedere (Marin County), Calif. "*Time*, because we make sales quicker now that the homeowner already knows about the need for *full* HOUSEPOWER before we see him, and *money* because people are now more apt to buy a real quality job. That means I make more. Homeowners quickly understand that adequate electric power increases the value of their homes. So I don't sell-down any more—I sell-up. Sell quality, not price alone. I'm happier that way, and the homeowner is happier, too."

New Sales Opportunities for Contractors

Yes, that's what contractors all over the country tell the HOUSEPOWER Reporter: Profits are much bigger. Why? Because contractors are making *bigger* residential rewiring sales than ever. Better quality sales. What's more, they make them quicker. Again and again, electrical contractors give credit to the HOUSEPOWER program for the increased business they're enjoying.

In Peoria, Ill., for instance, Miss Edna A. Crowl, a licensed electrical contractor, told the HOUSEPOWER Reporter: "The HOUSEPOWER program has made all the difference in the world to my business. The customer is already presold on the idea of getting adequate wiring. That paves the way for us to sell-up. Sell *quality*. That means better profits for the business."

Women are fed-up with the annoyances of *low* HOUSEPOWER and are eager to talk about ways of getting rid of the problem. That's why Miss Crowl, who is owner and manager of Crowl Electric Company, goes right to the heart of the matter—the



Crowl

kitchen—when she talks with a prospect. "Women have had the problem in their own kitchens," she says. "They know a good thing when they hear it, and *full* HOUSEPOWER is a very good thing for the homemaker. All in all, I'm delighted with the program. Makes closing these sales *so* much easier."

And in the South, too, HOUSEPOWER makes the difference. Ralph K. Robinson, president of Robinson Electric Co., Inc., Charlotte, N. C., says he has noticed a decided change in the attitude

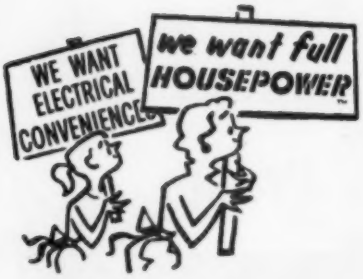


Robinson

of homeowners regarding the wiring in their homes—and in the services he sells. All due to the HOUSEPOWER program. "The HOUSEPOWER ads have really paved the way for at least 100 amp. service in the homes we now rewire," he reports. "The reason is clear. People now have a 'talking acquaintanceship' with the workings of their electrical systems. It's gratifying to have people call and *tell us* that their wiring system is inadequate. We seldom have to *tell them*. That makes it much easier for us to sell a quality job. The HOUSEPOWER ads have convinced homeowners that they will enjoy a whole world of time and work-saving benefits when they have *full* HOUSEPOWER. This makes for quick and easy selling . . . and more important, happy and satisfied customers."

Put HOUSEPOWER to work for you. The residential wiring modernization market offers you terrific opportunities to increase your business. Tens of millions of homes need wiring modernization. By using HOUSEPOWER selling tools, you can make sure that you get your share of the profits this market offers.

Continued on page 10



HOUSEPOWER Contest Means Sales Leads for You

On April 30th the $100,000 HOUSEPOWER Cartoon Caption Contest ended. The purpose of the contest was to educate more homeowners on the need for full HOUSEPOWER—and to bring you more leads for wiring jobs. The entries are in . . . and the contest was a whopping success. The final number of leads is not yet known. Long before the closing date, though, over 200,000 had been received. Thousands and thousands of prospective customers for wiring modernization!

Now's the time for you to act. These leads are being channeled back to your area. Contact your utility and find out how you can take advantage of these leads. In order to enter the contest, these people had to learn the symptoms of *low* HOUSEPOWER, as well as the wonderful benefits *full* HOUSEPOWER would give them. The best time for you to get in touch with these prospects is while the subject is still fresh in their minds. These leads can be your key to more business—more profits. Let your utility know today that you're ready to follow-up the leads in your area.

Rating Sheet and Estimate-Proposal Form Your Best Sales Aids

These new prospects are all more anxious than ever to know what their HOUSEPOWER rating is. Here's your chance. The Rating Sheet gives you a wonderful door-opener. Sit down with the homeowner and go over the Rating Sheet item by item. This will be a great advantage to you in two ways: (1) You'll find that the Rating Sheet helps you explain wiring to your prospects in language they can understand, and (2) homeowners become deeply interested in their homes' wiring systems when you show them on the Rating Sheet what the condition of their present wiring is—and what they need in order to bring it up to modern standards.



Many contractors make it a practice to take an Estimate-Proposal Form along when they call on prospects. They've found that it helps them sell jobs in one visit. Not only does the form provide a handy means of building-up and estimating the job, you get all these advantages, too:

- Proposal and contract form (in duplicate) for customers to sign then and there.
- Detailed work order for your journeymen.
- Does away with costly, time-consuming paper work.
- All in just one filling-out operation.

Use the Estimate-Proposal Form. You'll make the sale quicker, make more profit on the job when you do.

Sales Tips for Added Profits

Tell Customers How They Can Wire "On Time." When your prospects learn that they can pay in small monthly installments, they'll be far more willing to modernize their wiring. And you get paid in full right away. So it pays you to find out what time-payment plan you can offer them. Check these three ways of financing wiring to see which you want to offer your customers:

1. FHA-insured loan. Make it easy for your customers by giving them detailed information on how they can get this credit.
2. Property improvement loan made by banks and other lending institutions. Talk this over with the institution of your choice. Be ready to tell your customers exactly what steps to take to get such a loan.
3. Find out if your utility finances wiring modernization. It's a mighty attractive offer when you can tell your prospects that they can be billed through installments on electric service bills.

In short, make it easy for homeowners to get these loans. When they find that they can pay in installments, homeowners often buy a better quality job.

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Why not take advantage of this opportunity to build prestige, community respect, and added profits for your business? Write today for information about this exciting new plan.

Free Booklet Shows How to Build Business

It's called *An Idea Book for Business-Minded Electrical Contractors.* And it's full of ideas you'll want to use to promote more business. It's free. Send for your copy today. Use handy coupon below.

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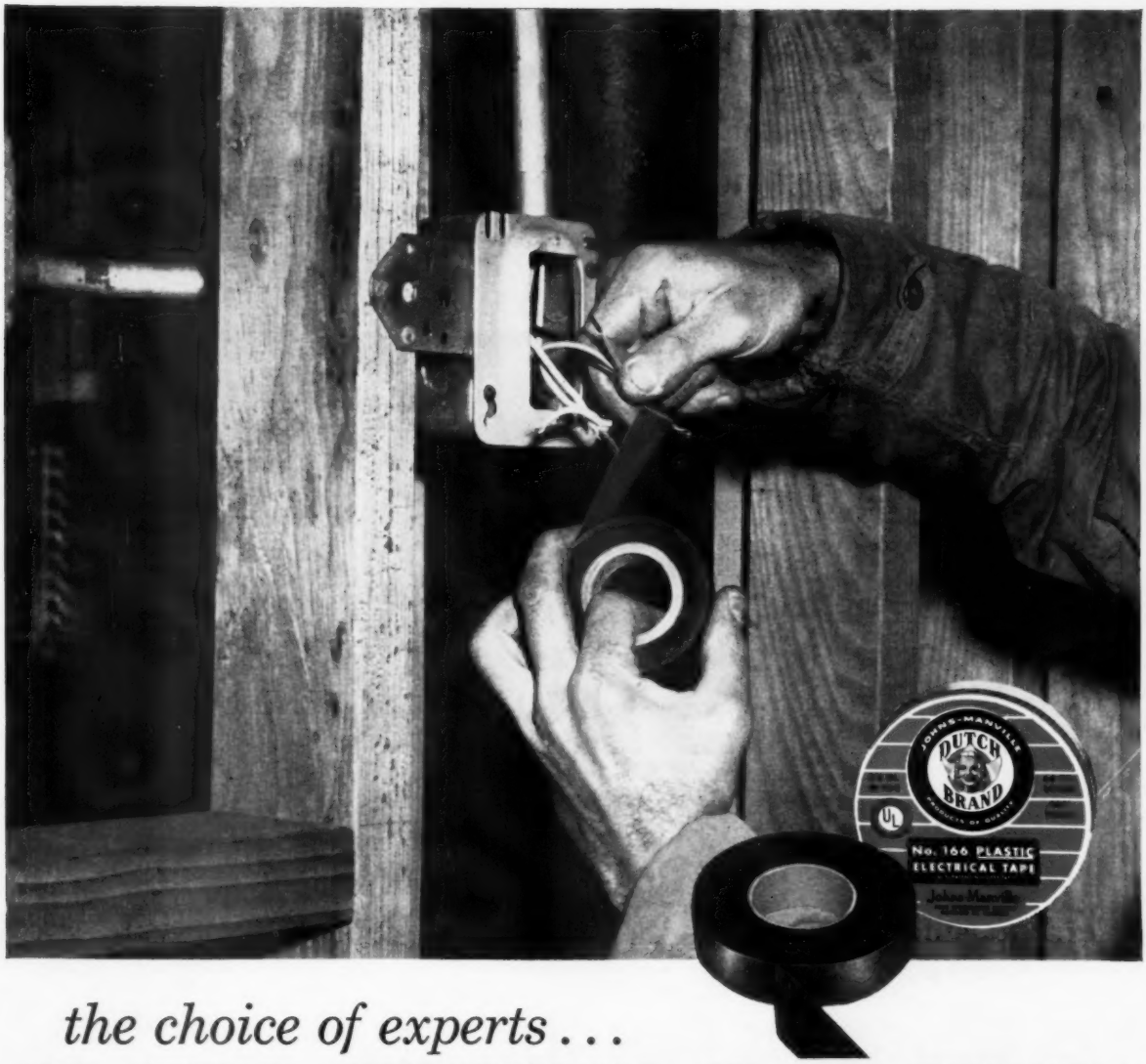
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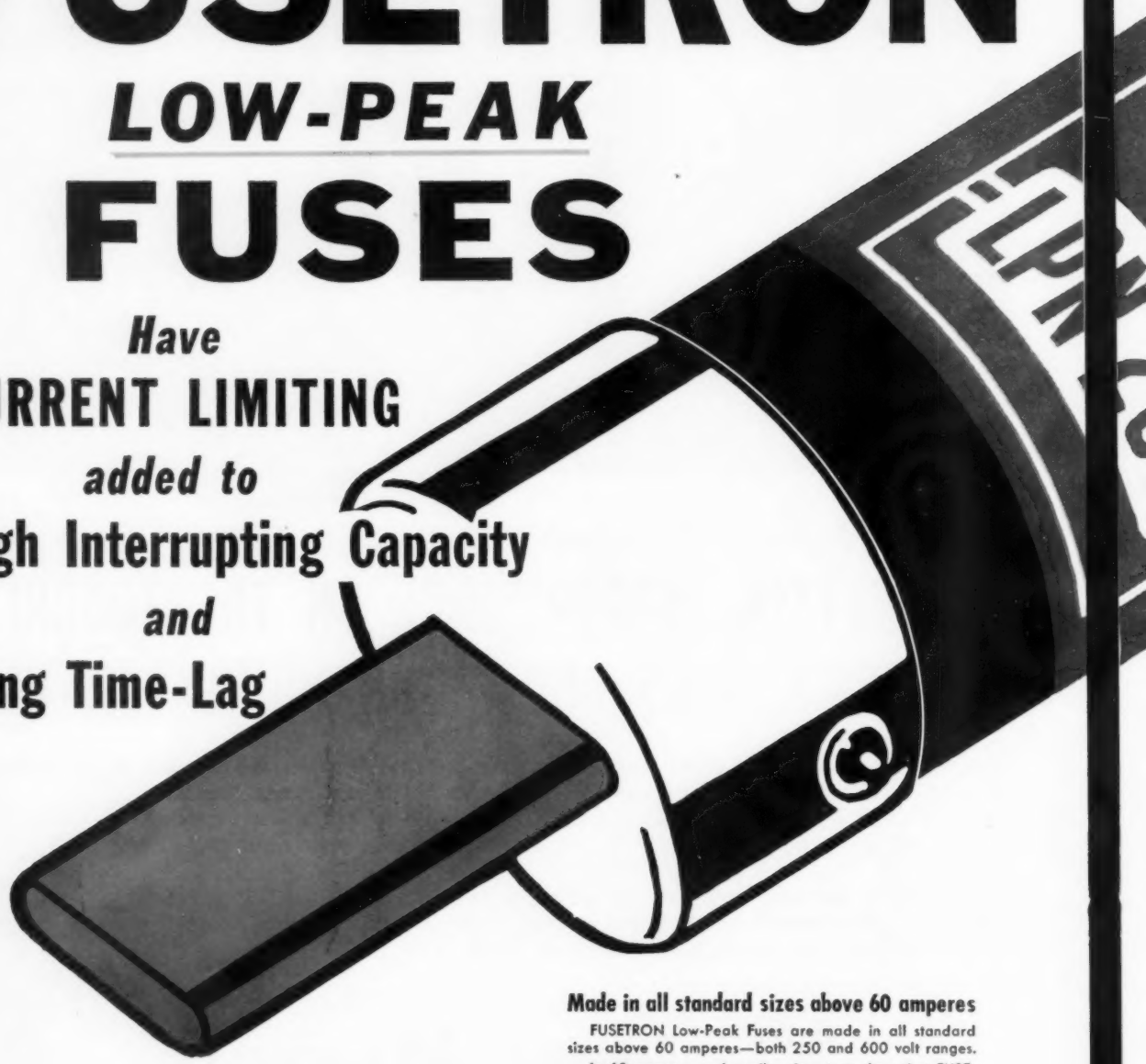
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added to

High Interrupting Capacity

and

Long Time-Lag



Made in all standard sizes above 60 amperes

FUSETRON Low-Peak Fuses are made in all standard sizes above 60 amperes—both 250 and 600 volt ranges.

In 60 amperes and smaller sizes tests show that FUSETRON dual-element fuses have sufficient current limitation to protect circuit and components in all normal cases.



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the same Time-Lag to hold harmless current surges

PLUS Greater Current Limitation to restrict fault currents to a LOW PEAK

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Where their use is required in any part of the electrical system, they can be installed without upsetting proper coordination over the range of useful loads and normal faults.

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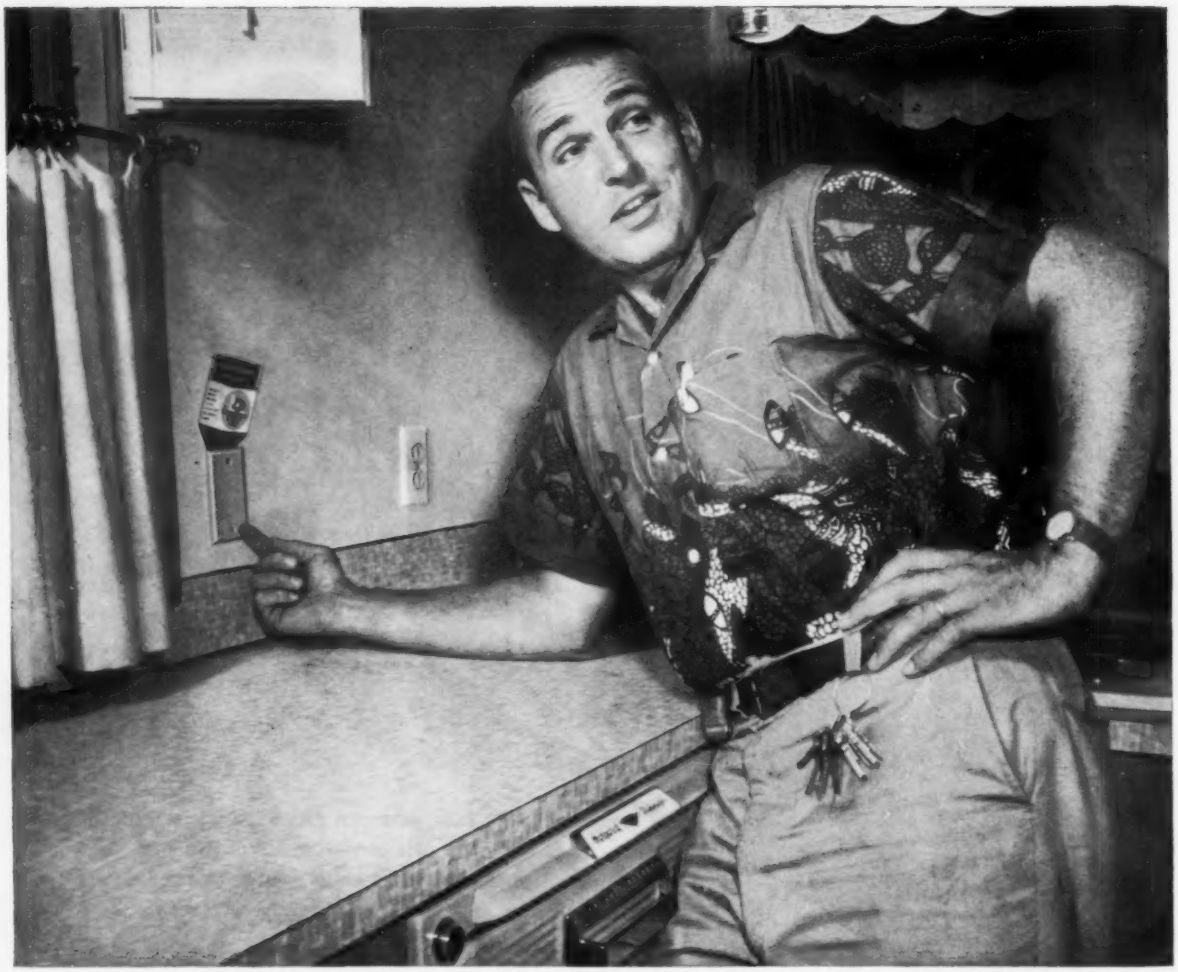
They are designed for use to protect circuits and components that might be damaged by the thermal and mechanical stresses of peak fault currents if other protective devices are used.

If planning new installations, keep FUSETRON Low-Peak Fuses in mind for those locations where peak fault current must be held to a low value.

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Mr. Billman points to the kitchen telephone outlet in one of his new Wilshire Park homes in Minneapolis.

"Concealed telephone wiring tells people that your homes are better planned"

— says Rodney W. Billman, Builder, of Minneapolis, Minnesota

"Not only are prospects looking for the big things about your house," says Mr. Billman, "the layout of the rooms, the way it faces the street, but they're looking for little things, too.

"Now, concealed telephone wiring is a little thing, perhaps. But if a prospect turns your house down because it doesn't have a desirable, modern feature like concealed telephone wiring — well, a little thing suddenly becomes a big thing. Big enough to lose a sale.

"Concealed telephone wiring means convenience. And neat, attractive installations. It tells people that your homes are better planned. We put it in every house we build, and our salesmen show the outlets to every prospect."

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Your local Bell Telephone business office will be glad to help you with concealed wiring plans. For details on home telephone wiring, see Sweet's Light Construction File, 8i/Be. For commercial installations, Sweet's Architectural File, 32a/Be.

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COMPACT, LOW-WEIGHT CONNECTORS WITH HIGH CURRENT RUPTURING RATINGS*



The new industrial series "C" Pyle-Star-Line connectors combine unique insulation and construction characteristics which make possible extraordinarily high circuit breaking ratings for the size and weight of the shell.

"Sandwich Insulation"—a resilient silicone insulation disc which floats between two rigid discs absorbs shock and vibration and permits the contacts to align themselves. The silicone, under pressure, reacts like a fluid. It flows into all crevices about the contact pins and sockets – positively prevents moisture or dust from passing through the insulation or accumulating to cause failures from short circuits or grounds.



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Rugged, Compact, Low-Weight Shell machined from high tensile strength aluminum...combined with the unique insulation features...provide a safe reliable, easy-to-handle connector which is highly resistant to the most punishing extremes of temperature, pressure, shock, vibration, corrosive dusts and moisture. Advantages never before combined in a single, standardized connector!

***Listed by Underwriters' Laboratories** in circuit breaking ratings of 30, 60, 100 and 200 ampere, 600 volt, A.C.

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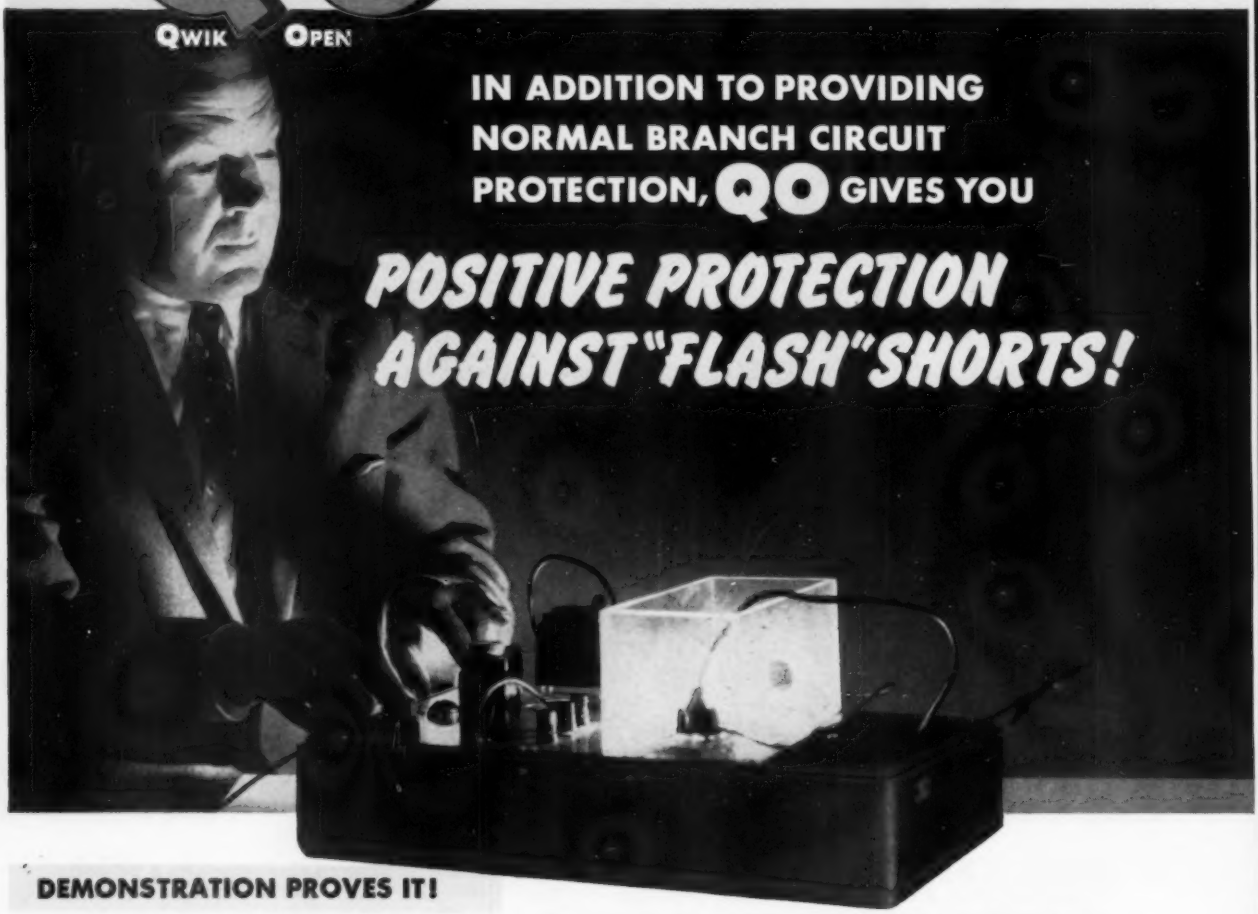
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Square D Field Engineers throughout the country are proving the superior performance of the **QO** breaker, using the demonstration kit shown above. It gives dramatic proof of positive protection against "flash" shorts. Mail the coupon on opposite page for the complete **QO** story. If you're of the "I'm from Missouri" clan—

MAKE A "DEMONSTRATION" DATE WITH YOUR SQUARE D FIELD ENGINEER!

Conventional overcurrent protectors provide protection for branch wiring for both overload and short circuits, but do not open fast enough to protect the smaller extensions beyond the branch wiring from repeated arcing or "flash" shorts. Such shorts consist of relatively low values of current and often produce spectacular flashes.

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BREAKER EVER BUILT BETTER...*and Here's Why*—



ACCIDENTAL "FLASH" SHORT

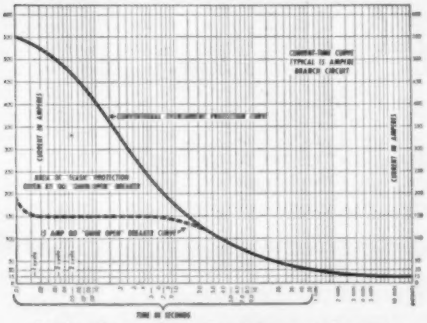
Accidental "flash" shorts occur by a slip—a screwdriver on a terminal, a fork in a toaster, a screw falling on a bus, a loose wire. The circuit should open instantly. With **QO** "Qwik-Open" breaker, the circuit opens *instantly* with the first flash, making the circuit safe.



FRAYED CORD "FLASH" SHORT

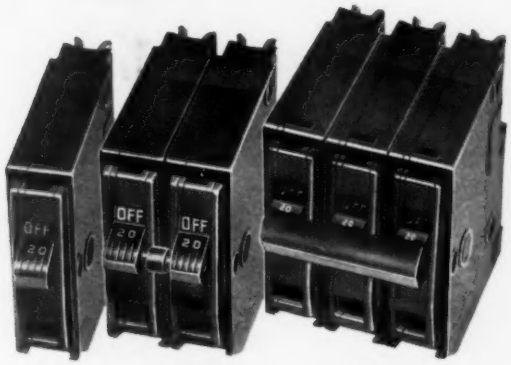
Stranded flexible cord "flashes" result principally from frayed cords. A few strands touch—the high resistance circuit gives off enough heat to burn through several strands. Further movement usually causes more strands to touch—another flash. With **QO** "Qwik-Open" breaker, the circuit opens *instantly* on the first flash. No known protection is faster.

TIME-CURRENT CURVE SHOWS QO PERFORMANCE



In the above chart, the **QO** curve illustrates the time-delay characteristic which eliminates nuisance tripping on momentary overloads and motor starts *plus* the extra protection over conventional protective devices which **QO** Qwik-Open breaker gives on the arcing "flash" shorts.

QO Gives Positive Protection Against Both Kinds of "Flash" Shorts!



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And—You Don't Need a "Road Map" To Use Square D's QO Breakers!

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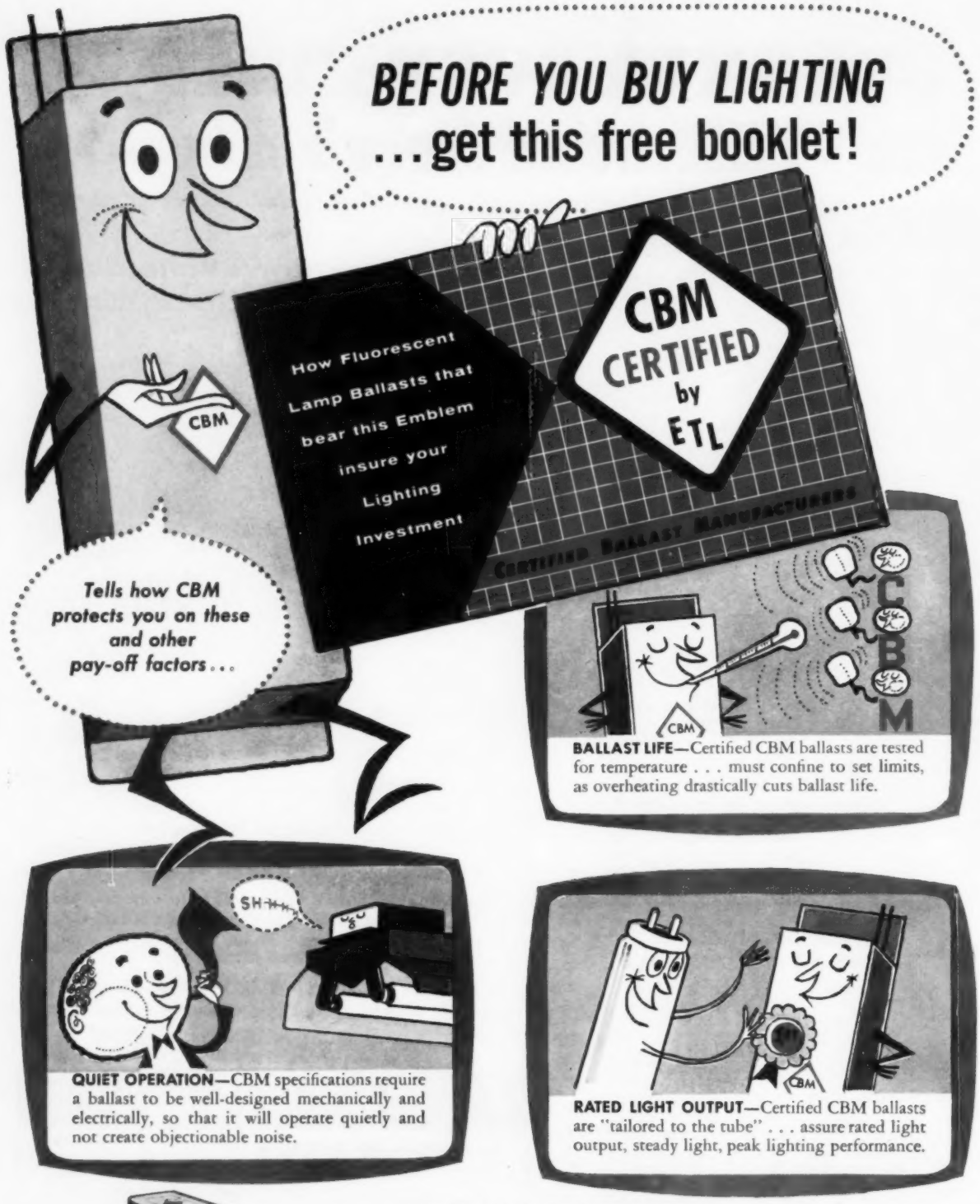
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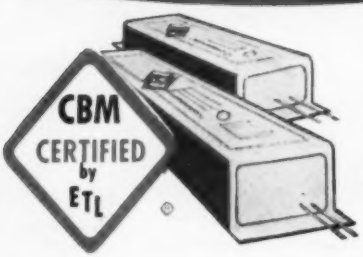
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BALLAST LIFE—Certified CBM ballasts are tested for temperature . . . must confine to set limits, as overheating drastically cuts ballast life.

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RATED LIGHT OUTPUT—Certified CBM ballasts are "tailored to the tube" . . . assure rated light output, steady light, peak lighting performance.



Send for this free booklet and learn how these factors and 11 others help insure your lighting investment when you buy fixtures equipped with Certified CBM ballasts.

Eight leading manufacturers now make up the association of

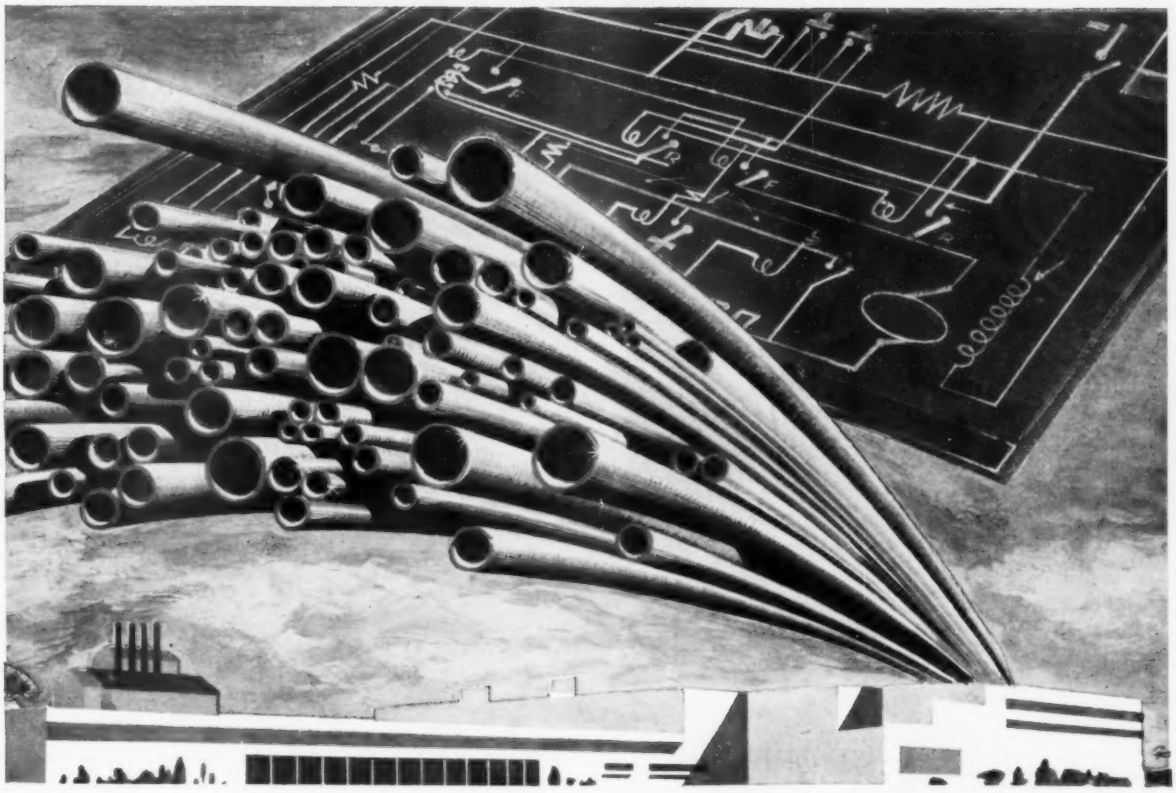
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Naugatuck KRALASTIC



Kralastic conduit cut labor cost 82%

In a West Coast plant construction job, 15,060 feet of Kralastic® thermoplastic pipe were laid as electrical conduit and covered with 53 yards of concrete in only 116 man-hours...82% less than if metal conduit had been used! Additionally, 24% was saved in cost of materials!

One man required but 20 minutes to make permanent, water-tight connections to 24 conduits installed in an excavation. This was possible only because Kralastic pipe can be cut with a hacksaw and solvent-welded, using sleeve-type joints, completely eliminating time-consuming threading operations and wrench work.

The light weight of Kralastic pipe (one-eighth that of steel) enabled a man to carry on his shoulder as much as 1,000 feet of 1½-inch pipe at one time, greatly facilitating its distribution and handling. Other advantages of Kralastic conduit are that it cannot rust or corrode, is not subject to electrolysis, and has a hard, smooth inner surface that makes wire pulling easy.

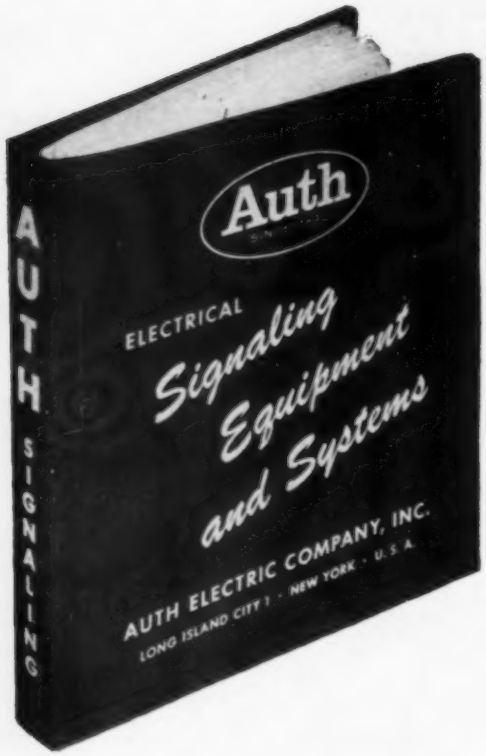
Kralastic pipe, up to 6 inches in diameter, is made and sold by leading plastic pipe concerns throughout the country. If not available in your community, write us for the name of the manufacturer nearest you. Remember, there are other types of plastic pipe...but Kralastic conduit pipe is in a class by itself!

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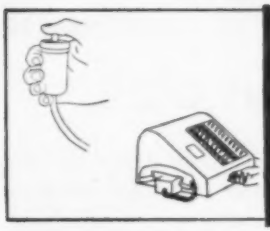
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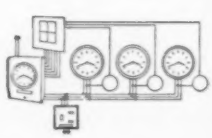
this new AUTH catalog for engineers, introducing a number of the latest designs in the signaling field, is available without charge if you are an engineer whose work includes specifying electrical signaling systems and signaling equipment. Complete with many carefully-written system specifications and wiring diagrams this indexed handbook also includes descriptions and illustrations of products and systems, dimension tables, and important functional data. Totaling more than 130 pages of useful technical information it should be extremely helpful to you in your work. Write on your letterhead for your copy today.

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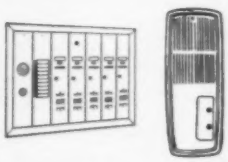
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- *In-and-Out Register*
- *Doctors' Paging*
- *Fire Alarm*
- *Clock*
- *Intercom Telephone*

Systems for
SCHOOLS



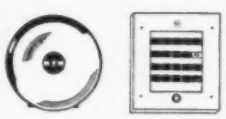
- *Clock and Program*
- *Fire Alarm*
- *Intercom Telephone*

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- *Apartment Telephone*
- *Apartment Mail Boxes*
- *Bell and Buzzer*
- *Door Chimes, Non-Electric*
- *Fire Alarm*

Systems for
INDUSTRY



- *Alarm Annunciator*
- *Clock and Program*
- *Wireless Paging*
- *Intercom Telephone*
- *Bell and Buzzer*
- *Fire Alarm*
- *Hold-Up and Burglar Alarm*

In addition to describing complete signaling systems the catalog also describes and illustrates numerous individual items of signaling equipment such as bells, buzzers, horns, sirens, push buttons, annunciators, transformers, and U. S. Approved Apartment House Mail Boxes.

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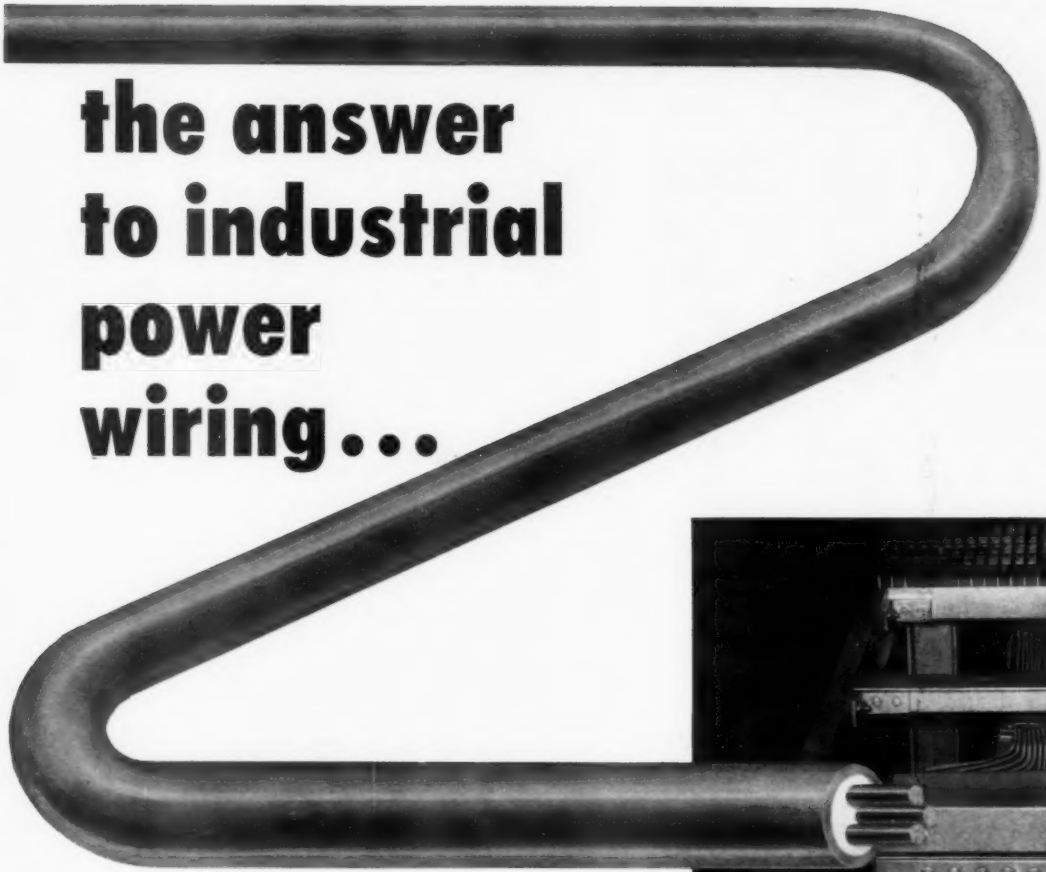
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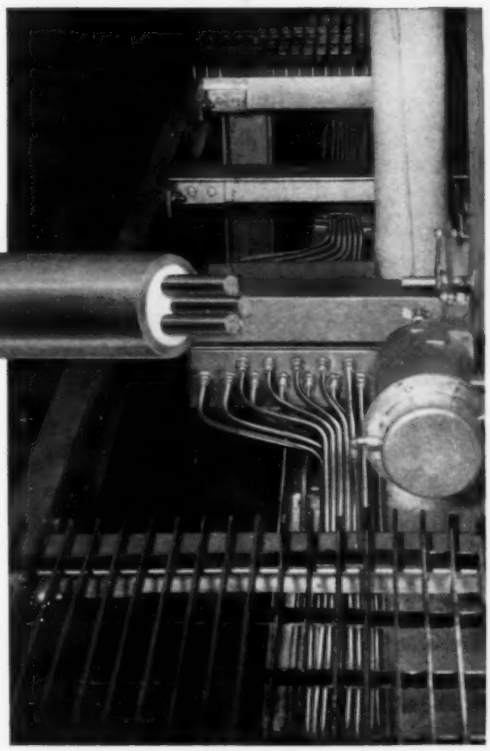
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There is a difference
ORDINARY CONDUIT is often difficult to bend

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Test results show G-E White bends as much as 19% easier than ordinary conduit. And it bends *right*, too—smooth, true, and even. There's a good reason: G-E White is galvanized by *metallizing*. Hot zinc is blasted onto the surface at such high speed the steel doesn't get overheated. There's no need, therefore, for quenching and straightening which tend to work-harden conduit galvanized by ordinary methods. So the steel in G-E White stays ductile . . . easy to bend.

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Couplings, nipples, and standard and long-radius 90-degree and 45-degree elbows are available from your General Electric distributor. For detailed information, call him today, or fill in and mail the coupon below.

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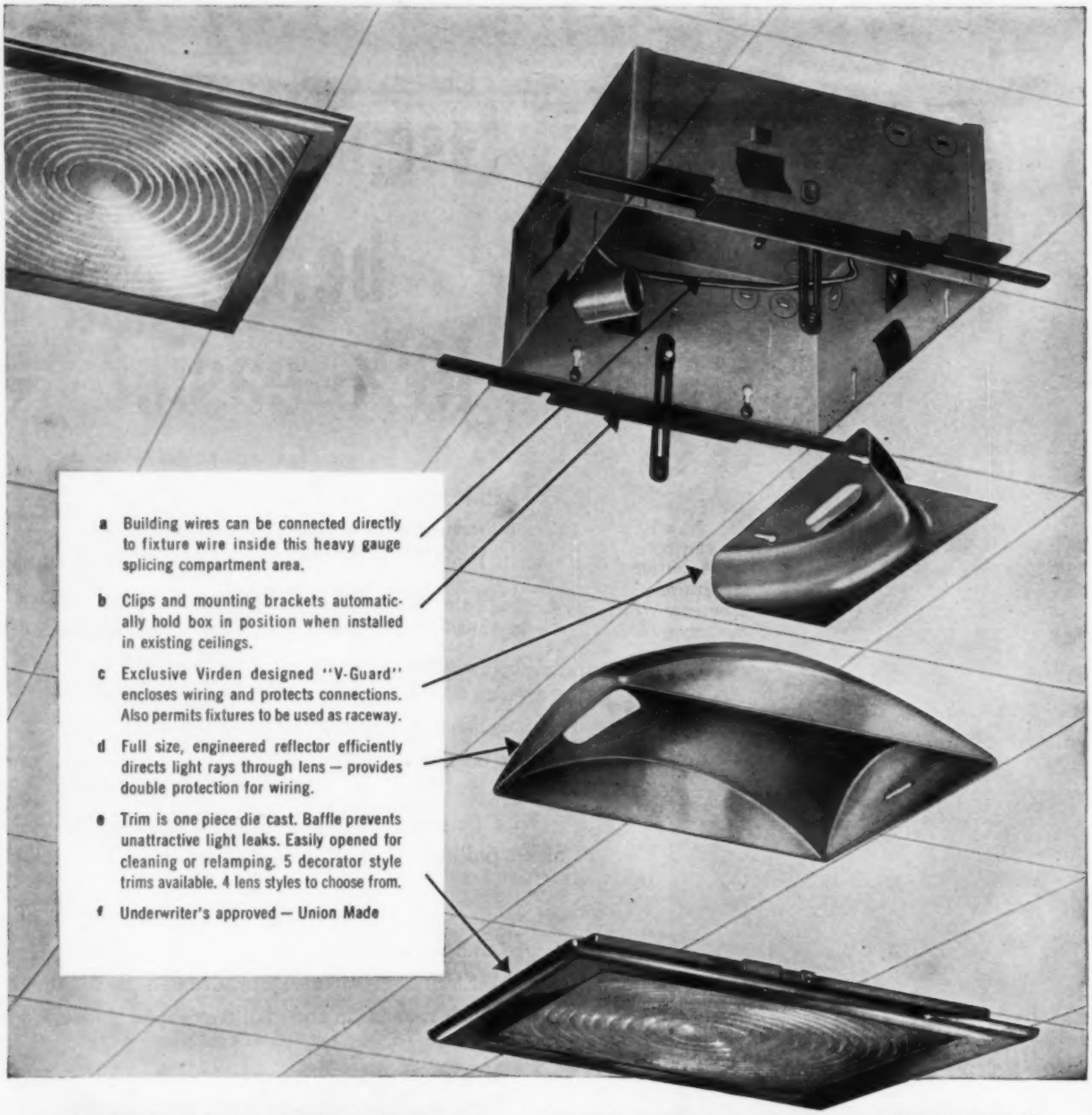
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75-Watt 8 x 8 x 5 Housing — 9⅛ x 9⅛ Trim

100-Watt 10 x 10 x 5 Housing — 11⅜ x 11⅜ Trim

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VIRDEN proudly presents the FIRST RECESSED FIXTURE that is INTERNALLY-PREWIRED!*

A major improvement by Virden! Now for the first time *all* wiring connections can be made within the fixture itself. No external outlet box to wire in. Standard house wire is entirely suitable for connections inside the housing. What's more, the unit can be used as a raceway if desired. And it has full Underwriter's approval.

The secret is Virden's exclusive design shown opposite. All parts assemble into one compact, square housing, permitting easier installation especially in areas with close quarters. The patented "V-Guard" covers all connections eliminating the need for an external outlet box. The specially engineered full size reflector not only improves lighting efficiency but serves as an added safeguard for the wiring.

In 3 sizes — 75 watts, 100 watts and 150 watts — the unit features a one-piece die cast trim, baffled to eliminate light leaks. Five trim finishes with four lens styles provide a wide range of decorative lighting possibilities, both indoors and out.

Use this new Virden fixture on your next lighting job. See for yourself how much easier it is to install, the wiring time it saves. Your Virden distributor has these new fixtures in stock now. Order yours today.

(*Patent Applied For)

FOR NEW WORK OR OLD – RESIDENTIAL OR COMMERCIAL



The compactness of this new Virden recessed fixture makes it an excellent unit for new work. It requires a minimum of space. Has mounting brackets and adjustment slots for a tight fit on ceilings. Ample knockouts for fast wire connections. (hanger bars optional)



This new Virden fixture is ideal for installation in existing ceilings, too. Simply cut a hole 1/8" wider than the housing, insert in opening and wire. The special spring clips hold the housing snugly when used in conjunction with the mounting brackets.



The new Virden recessed fixture is excellent for commercial and residential use. Installation costs less and the 4 lens styles and finishes available make possible a wide range of efficient and decorative lighting, indoors and out.

VIRDEN Lighting

virden

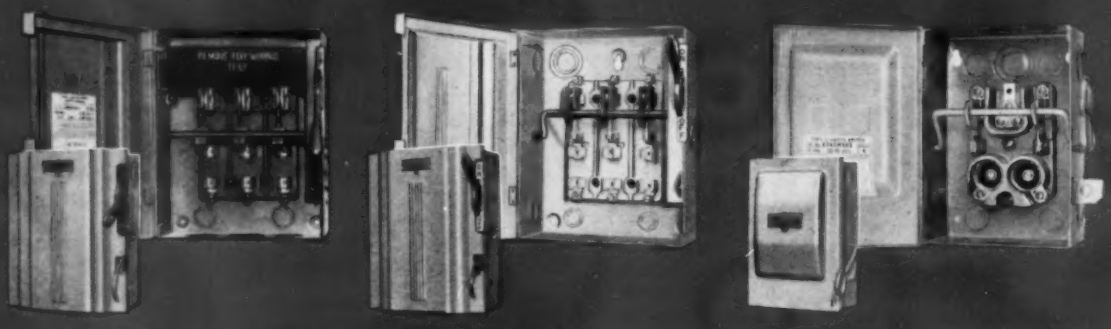
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WHATEVER YOU DO...

WHOEVER YOU SERVE...

it pays to use Cutler-Hammer Safety Switches



FOR HEAVY INDUSTRIAL SERVICE

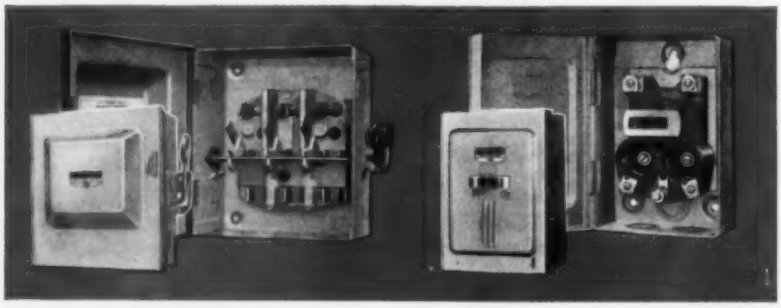
The Cutler-Hammer 4105 Heavy Duty Type A Safety Switch is specifically designed and constructed to insure safe, dependable performance under the most severe operating conditions. *Features:* "heat-proof" design • high quality, heat resistant materials • duo-strength operating hooks • spring type fuse receivers • quick-change operating unit • available in all needed sizes, types and enclosures.

FOR STANDARD INDUSTRIAL SERVICE

The Cutler-Hammer 4131 Normal Duty Type C Safety Switch provides economical circuit disconnect service for all standard industrial and commercial applications. *Features:* quick make and break mechanism • single break, double faced contacts with reinforced jaws • wiping-action arc snuffers • solderless lugs • available in a wide range of sizes, types, and enclosures.

FOR LIGHT DUTY DISCONNECT SERVICE

The Cutler-Hammer 4141 Light Duty Type D Safety Switch serves as an ideal low cost circuit disconnect for all light duty, general purpose applications. *Features:* plug type fuse holders • positive make and break mechanism • Easy-tite screw terminals • shock-proof fuse holders • formed contact clip construction • 30 ampere capacity, 125/250 volts • NEMA 1 and 3 enclosures.



FOR LIGHT DUTY GENERAL SERVICE

Designed for low cost circuit disconnect and service entrance applications, the Cutler-Hammer 4143 Light Duty Type D Safety Switch is widely used with heavy lighting, heating and range circuits. *Features:* cartridge type fuse receivers • positive make and quick break mechanism • formed contact clip construction • available in a wide range of sizes, types, and enclosures.

FOR LIGHT DUTY A-c SERVICE

The Cutler-Hammer 4151 Light Duty Type D Safety Switch is ideally suited for low cost, domestic motor disconnect such as oil burners and power tools. The 4151 is unusually compact and yet, easily installed and wired. *Features:* toggle operated • double break, butt type silver contacts • shock-proof, plug type fuse holders • 30 ampere capacity, 120/240 volts A-c • NEMA 1 enclosure.

EXTRA VALUE

CUTLER-HAMMER

SAFETY SWITCHES

C-H

AT NO EXTRA COST

For prompt attention to your safety switch requirements, see your nearby Authorized Cutler-Hammer Distributor. Also write today for the latest edition of the Cutler-Hammer Merchandiser . . . the handy motor control purchasing guide. CUTLER-HAMMER Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

Cut costs... without cutting corners! Specify... GEDNEY CONDUIT BODIES

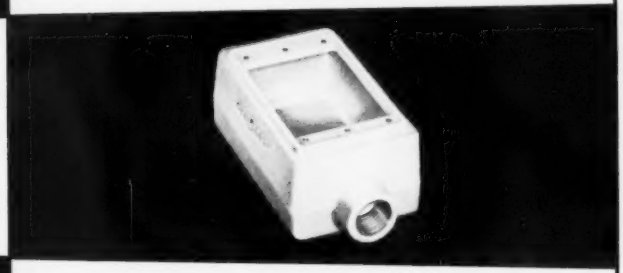
Gedney Conduit Bodies mean lowest installed cost! That's because they are skillfully made of tough, *malleable* iron, then hot-dip galvanized, and finally, they must pass the toughest inspection. Accurate machining and threading assure easiest installation . . . ruggedness assures longest service life!

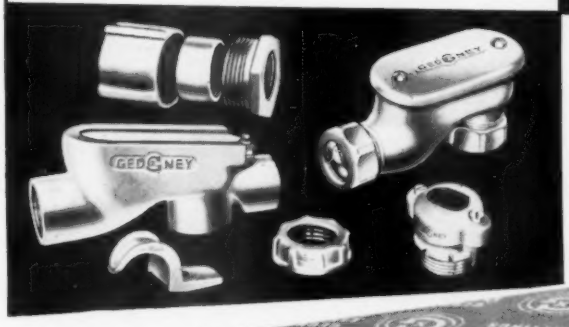
THE GEDNEY CONDUIT BODY LINE INCLUDES ALL TYPES—SIZES ½" TO 4"



TYPE LB—Threaded—for heavy-wall rigid conduit. Use them with Gedney entrance fittings, straps, clamp backs to get an *entire* conduit system that is hot-dip galvanized.

TYPE FS—Threaded—shallow bodies for heavy-wall rigid conduit. Hot-dip galvanized finish prevents corrosive deposits—means easier installation, longer life.





SCORES OF OTHER GEDNEY FITTINGS are available for every purpose—all carefully designed, manufactured and inspected to assure economical installation and maximum customer satisfaction.



GEDNEY
ELECTRIC COMPANY

GEDNEY

RKO BLDG., RADIO CITY, NEW YORK 20
Foundry, Factory and Shipping Point: Terryville, Conn.

GEDNEY FITTINGS FIT

YOUNGSTOWN "BUCKEYE" CONDUIT

. . . protects wiring system of Cleveland's new $5 million air terminal

Highly functional—yet strikingly impressive, describes the new Terminal Building at Cleveland's Hopkins Airport. It's part of an $8 million improvement program that will restore Cleveland's position of national prominence in the air transportation industry.

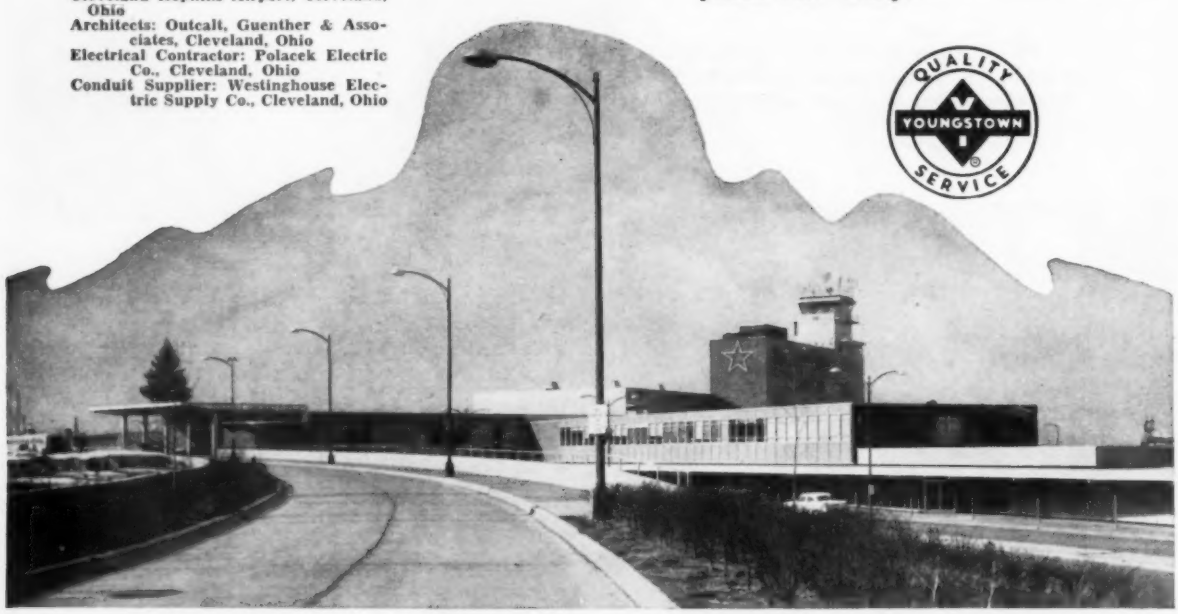
Planners of the airport's revitalization project wisely specified Youngstown's "Buckeye" Full-Weight Rigid Steel Conduit for life-time protection of the Terminal's all-important electrical wiring system. Electrical systems that fail to function properly are definitely a bad investment.

To keep your electrical systems functioning properly, specify quality-controlled Youngstown "Buckeye" Conduit. Satisfied users tell us, "It's easier to bend and thread — easier and faster to fish wires through, and due to its superior corrosion-resistance, gives a much longer, trouble-free service life."

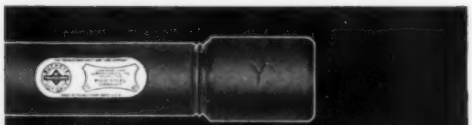
"Buckeye" Conduit is the specification of many leading building owners, architects and contractors—why not make it yours, now?

Leading distributors in the industrial and electrical markets carry complete and ample stocks for on-the-spot delivery to your job sites. They're awaiting your phone call—today.

Cleveland Hopkins Airport; Cleveland, Ohio
Architects: Outcalt, Guenther & Associates, Cleveland, Ohio
Electrical Contractor: Polacek Electric Co., Cleveland, Ohio
Conduit Supplier: Westinghouse Electric Supply Co., Cleveland, Ohio



THE YOUNGSTOWN SHEET AND TUBE COMPANY
Manufacturers of Carbon, Alloy and Yoloy Steel
General Offices - Youngstown 1, Ohio
District Sales Offices in Principal Cities



Standard-threaded rigid steel conduit is the only wiring system approved today by the National Electrical Code as moisture-, vapor-, dust- and explosion-proof for use in hazardous locations and occupancies.

RACO

You Can Always Rely On RACO

ADJUSTABLE BARS

✓ **QUICKLY POSITIONED**

✓ **EASILY INSTALLED**

✓ **SAVES TIME**



NEW STOP-LOCK

Prevents bar from slipping apart accidentally. Permits separation of bar if desired.

SERRATED NAILS ARE PRE-ASSEMBLED TO THE BAR

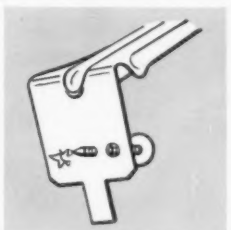
Ready for immediate installation.
No hunting for nails.

SELF-GAUGING



SHALLOW OFFSET

Place gauging lug against edge of rafter or joist and nail in place.



DEEP OFFSET

Straighten gauging lug and line up flush with edge of rafter or joist.

✓ **EXTRA STRONG**

THE ONLY BAR ON THE MARKET WITH RIGID "M"* CONSTRUCTION

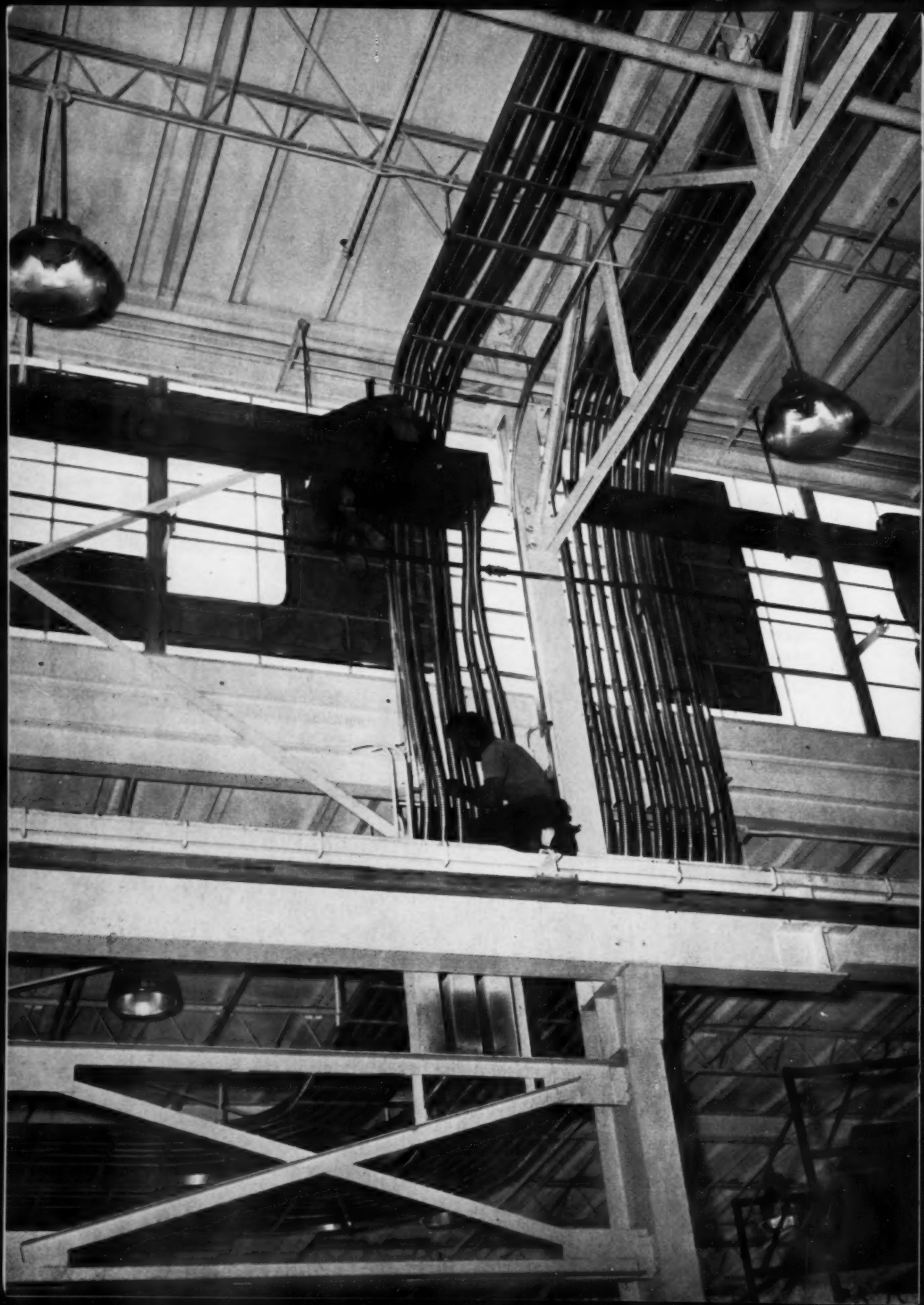


RACO Adjustable Bars have been vastly improved. Note these extra advantages . . . pre-assembled serrated nails for easy installing . . . self-gauging lugs for fast positioning . . . friction stop-lock that prevents bars from accidentally slipping apart. High quality electro-galvanized finish. Write today for new bulletin describing these superior Raco Adjustable Bars.

ONLY 4 BARS DO THE WORK OF 16

Simplifies stock control . . . requires less investment in inventory. Two sizes fit most every job.

ASE RACO **ALL-STEEL EQUIPMENT INC.** Aurora, Illinois

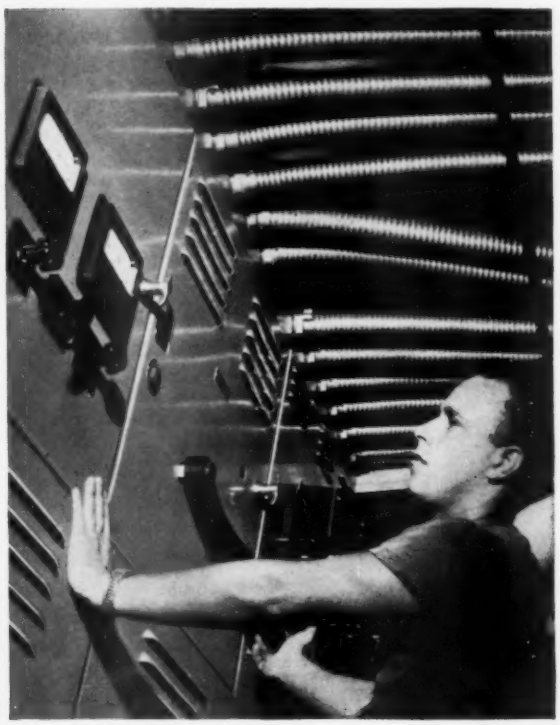


This picture shows why . . .

Anaconda's Duralox Cable cuts installation costs up to 50%

Duralox needs no conduit— saves time, money, manpower.

Duralox* is already enclosed in durable, yet flexible, metal armor. Thus, it can be installed *without* conduit—in long runs over and around obstructions, in trays, indoors or out.



THE FLEXIBILITY of Duralox Cable enables neat, efficient installation and facilitates equipment and terminal connections.

FITTING NEATLY AROUND BEAMS, Anaconda Duralox Cable is installed at Louis Allis Company, Milwaukee. Cable is 600 volt, 500 Mcm cable, varnished-cloth insulation.

You're in – and out – of plants quicker. Make the most efficient use of available manpower.

For your clients—Duralox is easily moved and 100% salvageable—makes their entire plant operation more flexible.

And Duralox's lower reactance in higher voltages—because of the close spacing of conductors—results in reduced voltage drop and more efficient power distribution.

Anaconda Duralox Cable is available in all popular sizes and voltages—copper or aluminum conductors with paper, rubber, plastic or varnished-cloth insulation.

Talk to the Man from Anaconda about Duralox for *your* future jobs.

*Reg. U. S. Pat. Off. 58307C

BULLETIN DM5606 on Anaconda Duralox Cable and sample specs are yours for the asking. Write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.



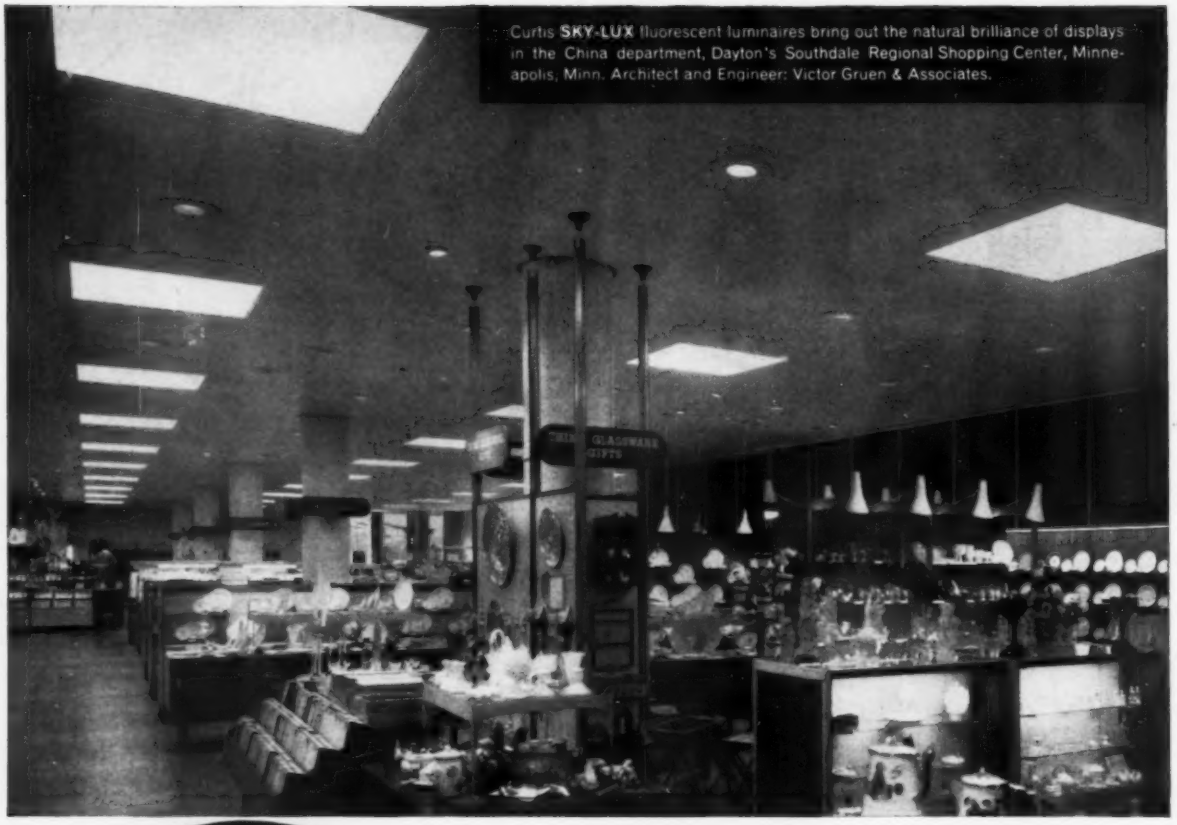
LIVE BETTER ELECTRICALLY

SEE THE MAN FROM

ANACONDA®

FOR **DURALOX POWER CABLE**

Foresight is a habit with Curtis... Visioneers in planned lighting



Curtis **SKY-LUX** fluorescent luminaires bring out the natural brilliance of displays in the China department, Dayton's Southdale Regional Shopping Center, Minneapolis, Minn. Architect and Engineer: Victor Gruen & Associates.



4' x 4' Surface Mounted **SKY-LUX** With CurtiCell Louver Diffuser



2' x 2' Recessed **SKY-LUX** With Dished Concave Acrylic Diffuser

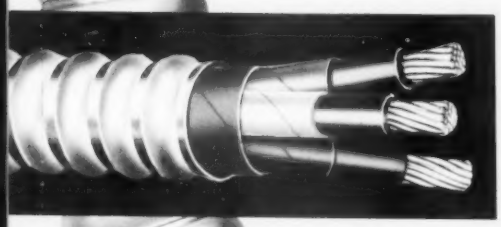
High-level illumination in modern low-ceiling design achieved with Sky-Lux Luminaires

The evolution in modern building methods challenges the skill, originality and versatility of product manufacturers as well as designers and engineers. Anticipating the trend to low-ceiling structural design in today's commercial interiors, Curtis visioneers meet the demand for large area fluorescent lighting that combines overhead beauty with properly diffused general illumination. Curtis SKY-LUX luminaires complement all the esthetic qualities of modern architectural form . . . provide controlled high-level illumination void of objectionable shadows. Curtis can supply many types of bottom enclosures in many sizes of large area fluorescent luminaires, either recessed or surface mounted. Write today for complete information about Curtis SKY-LUX. Curtis Lighting, Inc., 6135 W. 65th St., Chicago 38, Illinois. In Canada: 195 Wicksteed Ave., Toronto 17, Canada.

CURTIS

Visioneers in Planned Lighting®

TRIANGLE'S FLEXIBLE INTERLOCKED ARMOR CABLE

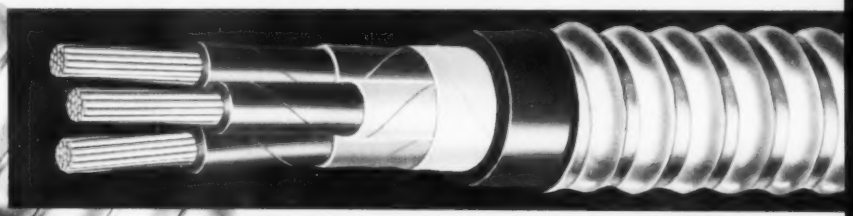


installs quickly, easily . . .

WITHOUT CONDUIT

- for new construction
- for changes in plant layout and expansion
- for rewiring older buildings

...Saves on Labor and Material Costs



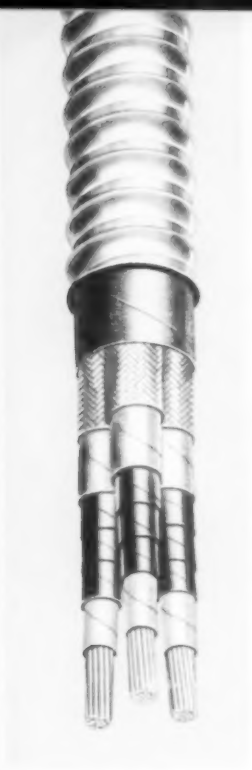


Why not tear this out and file for future reference?

TRIANGLE CONDUIT & CABLE CO., INC.

New Brunswick, New Jersey

"It MUST Be Right!"



interlocked armor cable meets a variety of application needs

Triangle Interlocked Armor Cable is widely used for primary and secondary feeders in power distribution systems; for station auxiliaries and generator leads; and as station control cable. This cable can be trained and twisted around building columns, bends and obstructions, permitting the use of long continuous lengths.

types of installations

For new construction, Interlocked Armor Cable power systems have several advantages. They provide reliability of service at low installed cost, and accessibility for making future changes in plant layout. Adding circuits to meet increased power demands is a simple matter.

For plant expansion, changes in plant layout and modernization, these systems offer the same advantages. Furthermore, they are not limited by capacity of existing conduit, and are readily interconnected with older systems with terminals, taps, connectors, and other accessories now available.

For rewiring older buildings to take care of today's increased power loads, interlocked armor cable may be the only economical answer. To install "conventional" systems would be prohibitive in cost. With interlocked armor cable, new circuits or additional circuits may be pulled in around beams and other obstructions without structural changes.

insulations to match applications

TRIOZONE — Suitable for use in wet or dry locations with a maximum operating temperature of 85°C, this compound is a special development of Triangle, and has exceptional ozone resistance plus heat and moisture resisting qualities.

ASBESTOS-VARNISHED CAMBRIC — This insulation is a combination of asbestos, varnished cambric tape and asbestos in sandwich form. Exceptionally good for high ambient temperature operation, this insulation also possesses high dielectric strength.

VARNISHED CAMBRIC — Applied also in tape form, this high dielectric strength material operates at maximum temperature of 85°C. The impregnated tapes resist oils, greases and moisture.

tough built-in conduit-type protection with interlocked armor

STEEL

A galvanized steel tape, which resists corrosion, forms the outer covering for interlocked cables. The tapes are formed to lock, one convolution with another, so as to offer full mechanical protection.

ALUMINUM

Where added protection is desired against corrosion, the light metal aluminum can be used in tape form. It is applied in the same manner as the steel tapes.

advantages

SIMPLE and RAPID INSTALLATION — Design and layout time are greatly reduced. Triangle interlocked armor cable can be quickly installed in trays and racks.

EASY MAINTENANCE — Ready accessibility of cable in racks permits quick location of cable faults and circuit tracing. No venting or draining is necessary.

CIRCUIT FLEXIBILITY — Relatively little loss of material occurs in the rearrangement of an interlocked armor cable system. Changes in plant layout are handled with ease, even where new circuits are to be added.

LOWER TOTAL COST — Triangle interlocked armor cable systems mean lower total cost of materials and installation combined. Up to 50% savings in installation costs offset occasionally higher material costs.

REDUCED SPACE REQUIREMENTS — Space savings are achieved whether with one or several cables. However, the percentage of space saved is less for a greater number of cables.

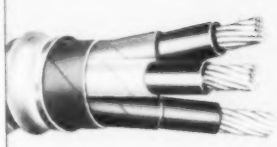
REDUCED WEIGHT — Weight saving by the use of light-weight aluminum Triangle interlocked armor and aluminum components is reflected in lower installation cost due to ease of handling.

Triangle Interlocked Armor Cables

TRIOZONE INSULATION — 3 CONDUCTOR*



0-600 VOLTS					4001-5000 VOLTS				
Size AWG or MCM	Thickness Triozone Insul. 64ths Inches	Approx. Diameter Under Armor	Approx. Outside Diameter (inches)	Approx. Ship. Wt. Per 1000 ft.	Size AWG or MCM	Thickness Triozone Insul. 64ths Inches	Approx. Diameter Under Armor	Approx. Outside Diameter (inches)	Approx. Ship. Wt. Per 1000 ft.
8	4	.710	1.030	500	8	10	1.120	1.440	1009
6	4	.750	1.070	635	6	10	1.205	1.525	1179
4	4	.995	1.315	848	4	10	1.310	1.630	1429
2	4	1.025	1.345	1170	2	10	1.440	1.760	1913
1	5	1.180	1.500	1416	1	10	1.505	1.825	2171
1/0	5	1.266	1.586	1678	1/0	10	1.610	1.930	2475
2/0	5	1.368	1.688	2011	2/0	10	1.710	2.030	2849
3/0	5	1.478	1.798	2514	3/0	10	1.825	2.145	3700
4/0	5	1.605	1.925	3027	4/0	10	1.950	2.270	3847
250	6	1.776	2.096	3542	250	11	2.120	2.440	4461
300	6	1.895	2.215	4091	300	11	2.240	2.560	5077
350	6	2.005	2.325	4639	350	11	2.350	2.670	5692
400	6	2.102	2.422	5191	400	11	2.450	2.770	6273
500	6	2.290	2.610	6290	500	11	2.635	2.955	7468
750	7	2.735	3.060	9072	—	—	—	—	—



VARNISHED CAMBRIC INSULATION TRIOSEAL COVER — 3 CONDUCTOR*



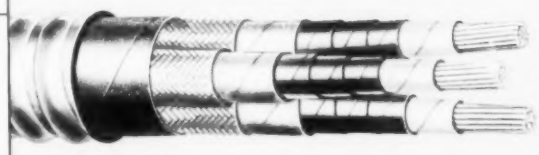
0-600 VOLTS						4001-5000 VOLTS				
Size AWG	Insul. Thick. 64th In.	Sheath Thick. Inches	Dia. Under Armor Inches	Dia. Over Armor Inches	Ship. Wt. Lbs. Per 1000 ft.	Insul. Thick. 64th In.	Sheath Thick. Inches	Dia. Under Armor Inches	Dia. Over Armor Inches	Ship. Wt. Lbs. Per 1000 ft.
8	3	.060	.621	.941	618	6	.080	.905	1.225	1050
6	4	.060	.796	1.116	752	6	.080	.987	1.307	1375
4	4	.080	.987	1.204	1233	6	.080	1.090	1.410	1782
2	4	.080	1.117	1.307	1609	6	.095	1.250	1.570	2044
1	5	.095	1.285	1.437	2018	6	.095	1.337	1.657	2263
1/0	5	.095	1.372	1.605	2441	6	.095	1.423	1.743	2628
2/0	5	.095	1.473	1.692	2767	6	.095	1.525	1.845	2984
3/0	5	.095	1.583	1.793	3517	6	.095	1.635	1.955	3495



ASBESTOS-VARNISHED CAMBRIC INSULATION ASBESTOS BRAID — 3 CONDUCTOR*



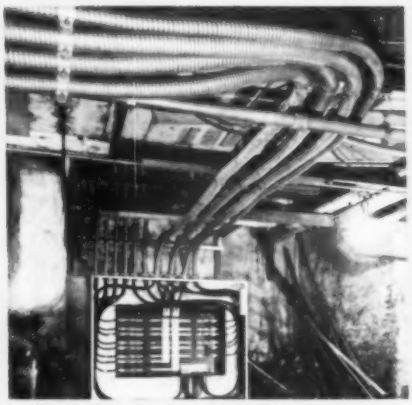
0-600 VOLTS					4001-5000 VOLTS			
Size AWG	Insul. Thick. Mils	Dia. Under Armor Inches	Dia. Over Armor Inches	Ship. Wt. Lbs. Per 1000 ft.	Insul. Thick. Mils	Dia. Under Armor Inches	Dia. Over Armor Inches	Ship. Wt. Lbs. Per 1000 ft.
4	65	1.058	1.378	1388	160	1.464	1.784	1847
2	65	1.188	1.508	1875	160	1.594	1.914	2231
1	80	1.318	1.638	2246	170	1.680	2.000	2563
1/0	80	1.406	1.726	2621	170	1.769	2.089	2978
2/0	80	1.505	1.825	3047	170	1.868	2.188	3378
3/0	80	1.616	1.936	3563	170	1.979	2.299	3895
4/0	80	1.741	2.061	4185	170	2.104	2.424	4548
250	105	1.990	2.310	4951	185	2.300	2.620	5319
450	105	2.415	2.735	7833	—	—	—	—



*Other voltage ranges and standard constructions are available

Why not tear this out and file for future reference?

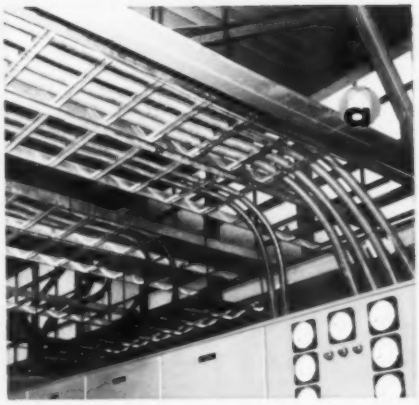
TYPICAL INSTALLATIONS



Because of its flexibility, interlocked armor cable provides a quick, economical way to install new circuits in an old building.



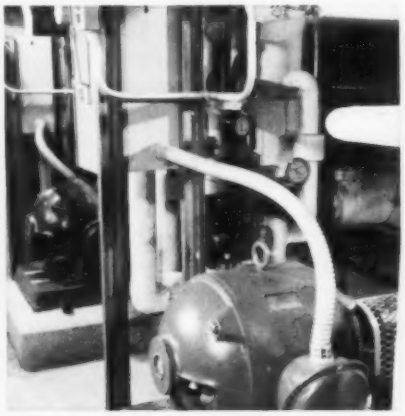
New cables can be added at anytime the electrical load increases and the need for additional capacity occurs.



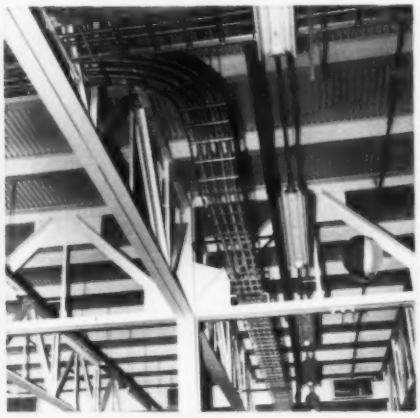
Multiple conductor control cable circuits are always accessible and easy to relocate.



Feeders to main power panels and load center sub-stations can be installed in long, unbroken runs without pull boxes and splices.



Interlocked armor cable speeds connections to motors and rearrangement of machines when equipment changes are necessary.



Installed in racks or trays, interlocked armor cables can be trained easily around corners and over beams.

MAIL THIS CARD TODAY

Triangle Conduit & Cable Co., Inc.
Triangle and Jersey Avenues
New Brunswick, New Jersey

Please send me more information on Triangle Interlocked Armor Cable ☐ I am also interested in receiving technical data on:

- ☐ Control Cable
- ☐ Varnished Cambric Cable
- ☐ Rubber Insulated-Trioprene (Neoprene) Covered Power Cables
- ☐ Street Lighting Cable
- ☐ Asbestos Insulated Cable
- ☐ Others, specify

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TRIANGLE CONDUIT & CABLE CO., INC.
New Brunswick, New Jersey

"It MUST Be Right!"

Bulletin 1A-10 Printed in U.S.A.



Guth brascolite

THE LINE FOR EVERY INCANDESCENT LIGHTING NEED

Whatever the lighting job—large or small, simple or complex—the Guth Brascolite *incandescent* line offers a fixture for every purpose. Now, from one *complete* source, you can figure the entire installation, without having to search through numberless catalogs to find the fixture you need. And every Brascolite listing gives *"Pre-Formance Data"*—complete lighting curves, interflectance coefficients and mounting-to-spacing ratios!

Whether the job involves a school, hospital, industrial plant, office or store... the Brascolite line and the comprehensive Brascolite catalog put the material you need right at your fingertips. Send for the Brascolite catalog today—a *complete* working tool for the *complete* incandescent line.



THE EDWIN F. GUTH COMPANY
2615 Washington Blvd. • St. Louis 3, Missouri

SPECIFY QUALITY . .

INSIST ON McGILL® PORTABLE LAMP GUARDS



McGill Industrial Lampguards give you an extra margin of quality—in materials and workmanship—that assure a safe dependable light; where you want it, when you need it. Parts and materials are all carefully selected for resistance to wear and abuse in rugged industrial service. 660 watt, 250 volt sockets. Choose the right lamp guards for your needs from the more than 100 different type offered by McGill.

Underwriters Laboratories Inspected



No. 7100 SR Lamp Guard

Clamp arrangement allows quick lamp changing without tools. Gray Neoprene-butyl handle, reflector, LEVOLIER® switch and extra heavy steel cage.

No. 5025 SRG Service Light

Completely grounded service light. 15 amp., 125 volt convenience outlet built into molded phenolic handle. Safe on-the-spot source for power tools, etc. 25 feet 16-3-SJ black rubber cord.



No. 5000 SR Lamp Guard

With 15 amp., 125 volt convenience outlet in impact and heat- and grease-reisting, positively insulating molded phenolic handle. No-Rol cage and reflector.



No. 3006
Vaporproof Lamp Guard

Watertight, vaporproof and moisture proof for complete safety. Heat and impact resisting glass globe screws into a silicone rubber gasket. Handle molded of macerated phenolic.



No. 652 Lamp Guard

Rubber hook handle, thumb release clamp for easy bulb replacement can be hung, for maximum light, from hook or handle.



No. 5000 SLRG Lamp Guard

Completely grounded. 15 amp,. 125 volt 3-wire convenience outlet for 2 parallel blades and a U shaped blade for ground. Molded phenolic handle. Resists oil, grease, breakage, moisture and abrasion. End lens concentrates light.

FREE

Send for free copy of McGill Catalog No. 84 .... today!

McGILL®
ELECTRICAL SPECIALTIES

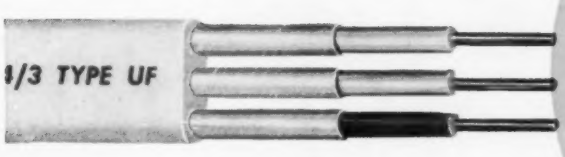
are always a little better and ***ALL*** *are Underwriters Laboratories Inspected*

McGILL MANUFACTURING COMPANY, INC. **450 N. Campbell St., Valparaiso, Indiana**

NEW!

savings on direct burial feeders





NEW!

COLUMBIA UF now in sizes thru 4/0

NEW!

lower material costs lower labor costs



1956 NEC regulations now permit the use of UF in single conductor sizes through 4/0 for direct earth burial (when provided with overcurrent protection) on 600 volt lines. Now you can save both on materials and labor by using Columbia UF in place of other types of more expensive cable or in place of wire and conduit combinations for direct burial applications.

Columbia UF is available in two and three-conductor assemblies, with and without ground wire, and in single-conductor sizes through 4/0.

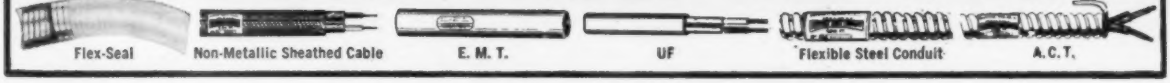
Approved by Underwriters' Laboratories

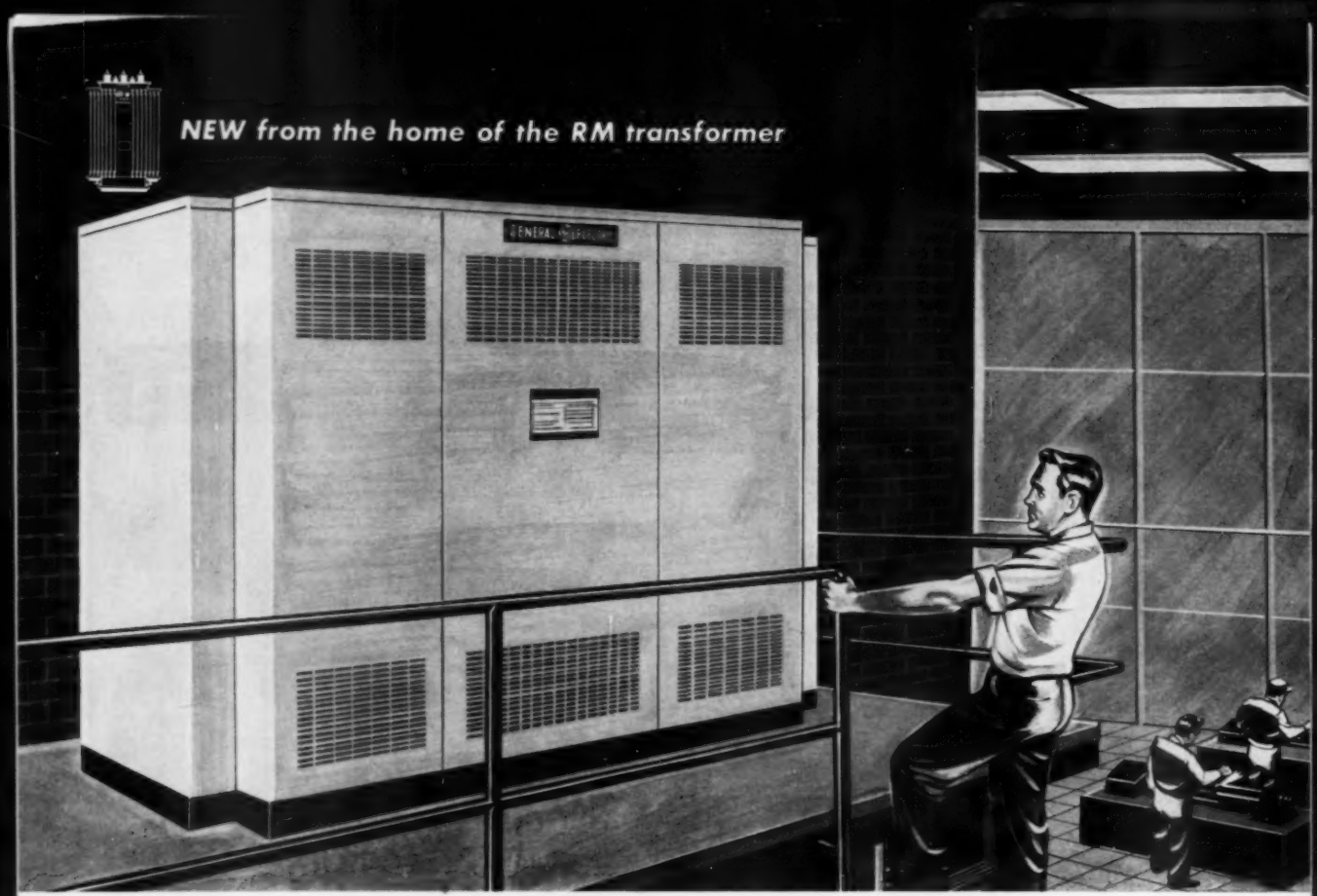


COLUMBIA CABLE & ELECTRIC CORP.

Serving the Electrical Wholesaler Since 1912

255 CHESTNUT STREET BROOKLYN 8, N. Y.





G-E OPEN DRY TRANSFORMERS . . .

Light in weight; require less maintenance

General Electric open dry-type transformers—available up to 7500 kva—are designed for power-near-the-load transformation where fire resistance and simplified maintenance are required.

LIGHT WEIGHT

The lightest type transformers available, these compact units are ideal for installation where floor space is at a premium. Their light weight allows overhead installation on catwalks, balconies, and other platforms.

REDUCED MAINTENANCE

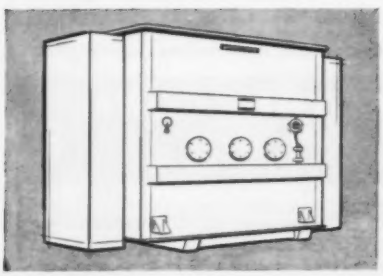
Exclusive silicone impregnation allows re-energizing unit after extended shutdown without special drying precautions. Occasional cleaning of core and coil structure is only maintenance required.

FULL INDUSTRIAL LINE

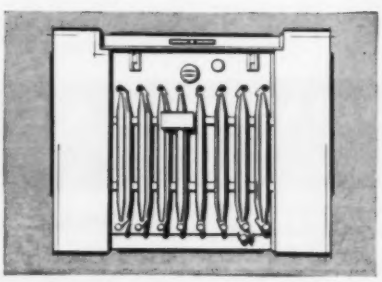
Regardless of your plant's operating conditions, there is an appropriate transformer in General Electric's complete line. Your G-E sales engineer can show you how you can save with faster shipment, easier installation, reduced maintenance, and longer transformer life. General Electric Co., Schenectady 5, N.Y.

417-2

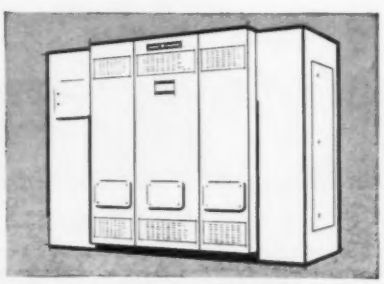
GENERAL ELECTRIC



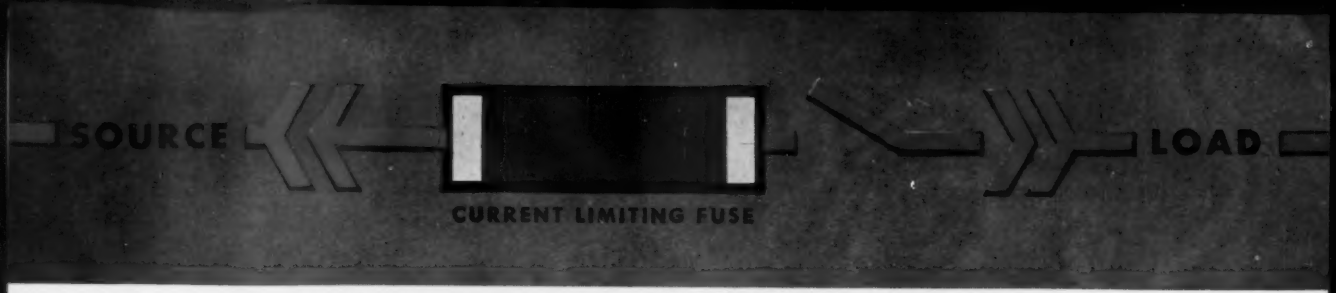
SEALED DRY-TYPE transformers feature light weight, long life, broad application.



LIQUID-FILLED transformers feature high impulse strength, broad application.



INTEGRAL DISTRIBUTION CENTERS are ideal "packages" for light power needs.



CURRENT LIMITING FUSE ON *SOURCE* SIDE OF SWITCH FOR SHORT-CIRCUIT PROTECTION

Improved protection with

General Electric ROLLOUT

Switch and Fuse Equipment

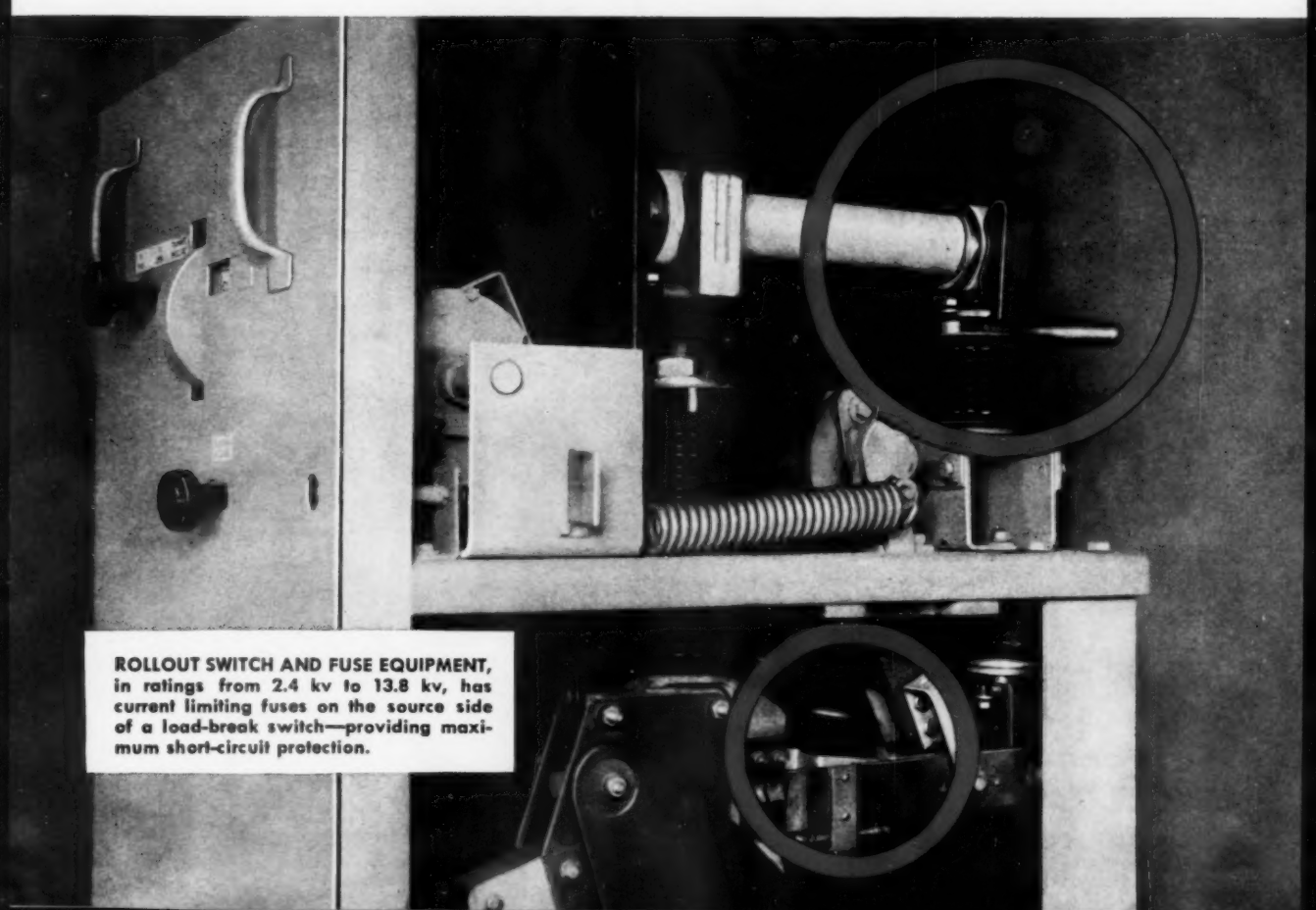
You get improved short-circuit protection with General Electric's new Rollout Switch and Fuse Equipment—because current limiting fuses are placed on the *source* side of a load-break switch.

You also get greater safety, easier maintenance and inspection, and installation versatility—with the new equipment's rollout feature.

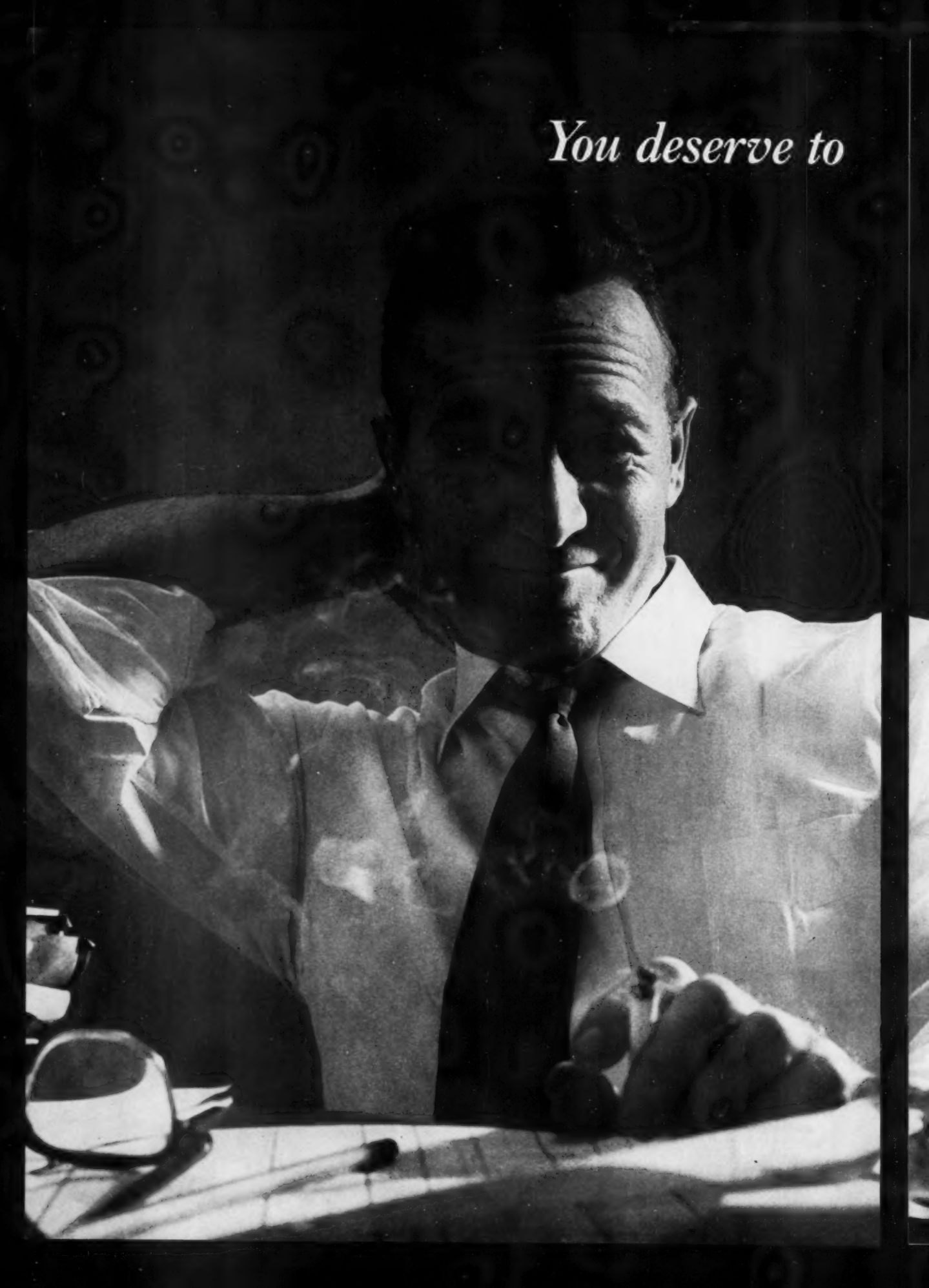
Call your nearest General Electric Apparatus Sales Office for more information or write for Bulletin GEA-6623, General Electric Company, Section B-514-3, Schenectady, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC



ROLLOUT SWITCH AND FUSE EQUIPMENT, in ratings from 2.4 kv to 13.8 kv, has current limiting fuses on the source side of a load-break switch—providing maximum short-circuit protection.


You deserve to



KNOW you've specified the best



. . . and you have a right to be pleased with yourself when you do. You've worked hard to design your client's electrical system. And you can't afford to risk specifying NOISY TRANSFORMERS . . . but are you?

You deserve the satisfaction of ***knowing*** the dry-type transformers you specify ***are*** the best . . . the quietest, most efficient, most economical transformers available. And you can get the best ***without paying a premium*** by specifying General Electric dry-type transformers.

When you specify G-E dry-type transformers, you're not just selecting a necessary control device between the power source and the power equipment. Instead, you're specifying QUIET OPERATION. General Electric ***Quiet*** dry-type transformers are sound rated according to the most rigid NEMA standards at a quiet 45 decibels or below. You're also specifying POWER ECONOMY, because G-E ***Quiet*** dry-type transformers are designed and built for maximum efficiency and reliable, long-life operation.

Be as demanding as you can when you're writing your specifications. Investigate ***all*** the dry-type transformers you have to choose from. You'll find General Electric dry-type transformers are an obvious choice every time. So why overlook the obvious? Specify General Electric ***Quiet*** dry-type transformers and get the satisfaction of ***knowing*** you've specified the best.

If there's a doubt in your mind, contact your nearest G-E Apparatus Sales Office for complete product information. Or, send in the coupon below.

Always Specify . . .

Quiet **G-E DRY-TYPE TRANSFORMERS**

GENERAL ELECTRIC

Send for this new bulletin before you specify another transformer.



SECTION B 411-4, GENERAL ELECTRIC CO.
SPECIALTY TRANSFORMER DEPT.
FORT WAYNE, INDIANA

Please send me the new bulletin "7 Guides for Selecting and Installing *Quiet* Dry-type Transformers," GED-3424, plus the new G-E Dry-type Transformers Buyers Guide, GED-6717, to help me specify.

NAME ..... **TITLE** .....

COMPANY .....

ADDRESS .....

CITY ..... **ZONE** ..... **STATE** .....

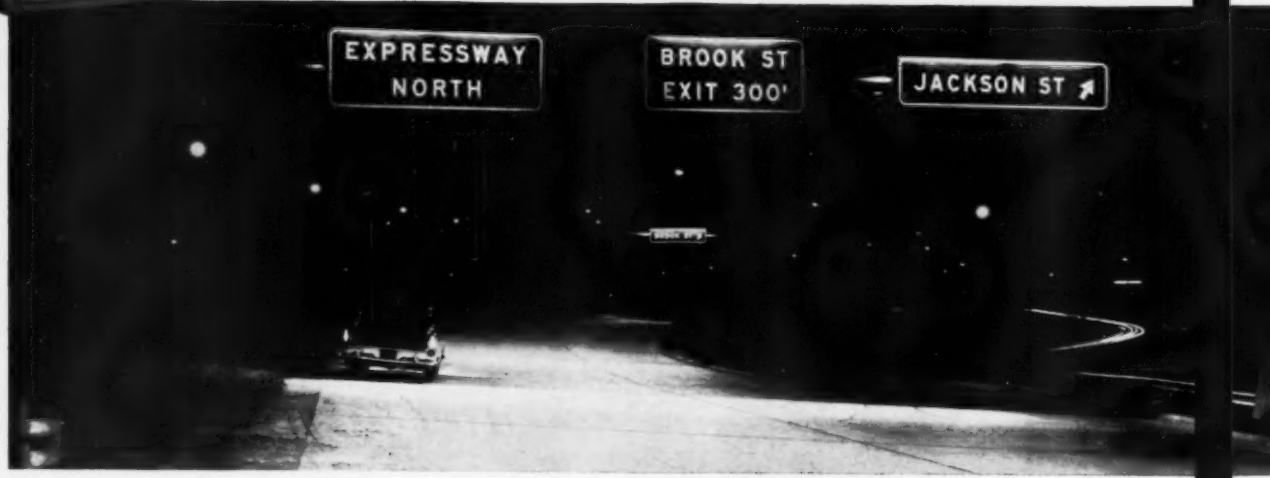


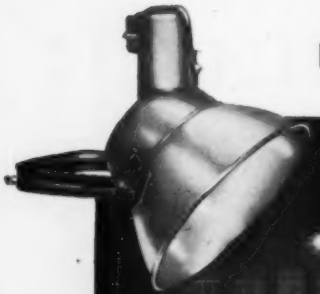
MERCURY Now available, 100- to 1000-watt mercury gives twice the light per watt, 2 to 6 times longer lamp life than filament. Economical for area lighting!





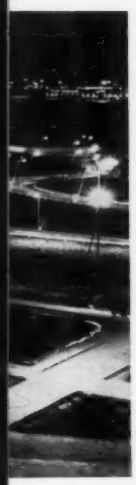
FLUORESCENT Fluoroflood fluorescent fixtures (used here for guide-sign lighting) now in 4-, 6-, or 8-foot lengths—for High Output or Power Groove lamps.





FILAMENT Available from 250 to 1500 watts, General Electric's complete line of filament floodlights includes a model just right for almost any application.





ONLY WITH GENERAL ELECTRIC OUTDOOR AREA FIXTURES CAN YOU CHOOSE FROM

ALL 3 LIGHT SOURCES

. . . AND GET THESE IMPORTANT BENEFITS

LOWEST COST CONSISTENT WITH HIGH QUALITY

Greater efficiency, more uniform light distribution, less maintenance, longer life—all mean savings for the user, now and later! General Electric premium-quality floodlights cost no more than ordinary floodlights! When you select General Electric floodlights, you can be certain you'll get the proper unit to do the job. Heavy-duty, general-purpose, or open units . . . fluorescent, mercury, or filament sources—General Electric has all the tools for your outdoor area lighting needs.

QUICK INSTALLATION, PRACTICALLY NO MAINTENANCE

Sturdily designed General Electric floodlights are quick and simple to mount, aim, connect, and maintain. The L-100, L-55, and L-80 series (filament and mercury) are equipped with threaded studs for 1½-inch conduit mounting; flat mounting bases are also available. The L-69A (filament and mercury) is mounted with galvanized-steel brackets, while the L-100 and L-55 units can be equipped with rugged cast aluminum supports. All parts are made of weather-resistant materials, and all floodlights are equipped with easy-to-read degree scales to facilitate aiming. Life of cable insulation and lamps is increased by cooler-operating General Electric floodlights.

MORE LIGHT PER UNIT, BETTER DISTRIBUTED LIGHT

As much as 35% more light—and more even light distribution—is provided by the exclusive "diamond-back" faceted reflector of General Electric's Type L-69A, L-100, and L-55 filament and mercury units. The optical design of the new Fluoroflood fluorescent fixture directs an optimum, uniform amount of light onto a surface, eliminating "hot spots" and dim areas. Large parking areas, highway guide signs, recreation facilities—whatever the application, modern General Electric outdoor area lighting fixtures do the job best.

AVAILABILITY FROM MANY DISTRIBUTORS' STOCKS

Coast-to-coast, more than 500 electrical distributors are franchised to supply General Electric floodlights from stock or by prompt shipment. Call in your distributor early on any floodlighting job. Besides application assistance, he can supply the complete lighting package—fixtures, lamps, cable, control, transformers, poles, etc.—to meet your needs.

Get all the facts on General Electric's complete line of mercury or filament floodlights, the Fluoroflood fixture, and the latest floodlight application practices. Just send in the coupon below, or contact your nearest General Electric floodlight distributor.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Section B451-198, General Electric Co., Schenectady 5, N. Y.
Please send me free information on the subjects checked below:

☐ Filament Floodlighting ☐ Mercury Floodlighting

☐ Fluoroflood Fluorescent Fixture ☐ Application manual, "How to Select and Apply Floodlights"

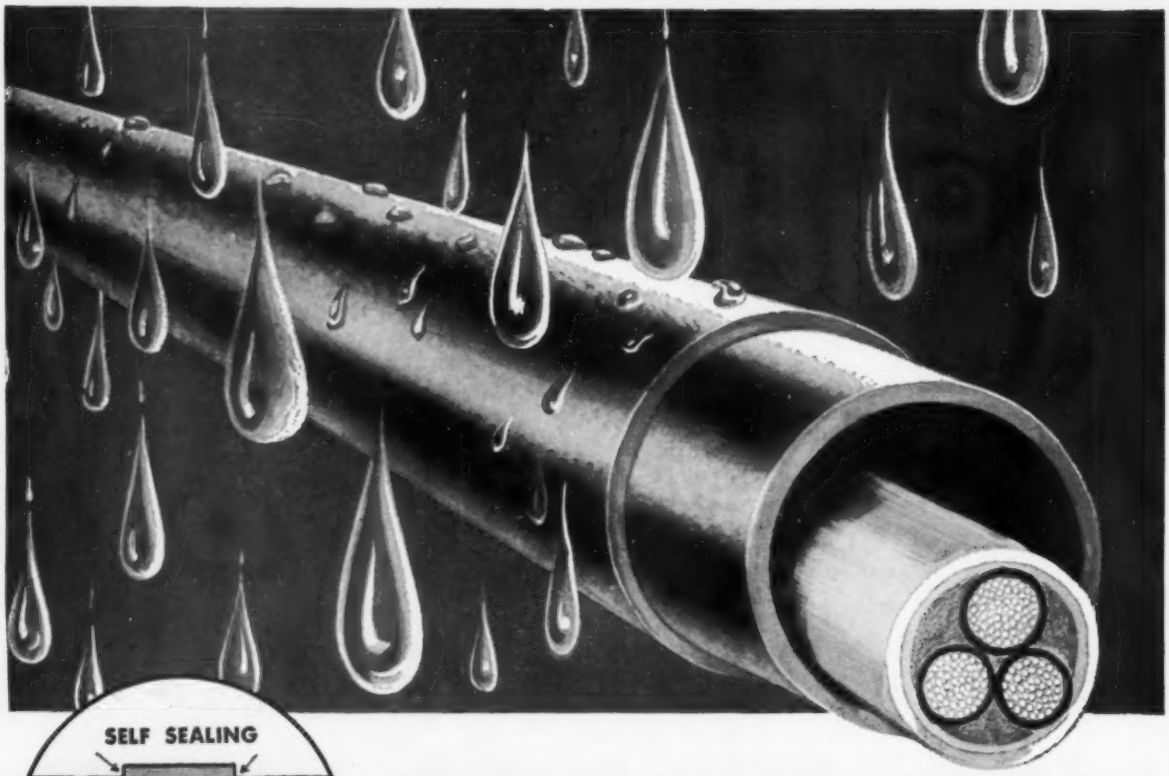
Name_____

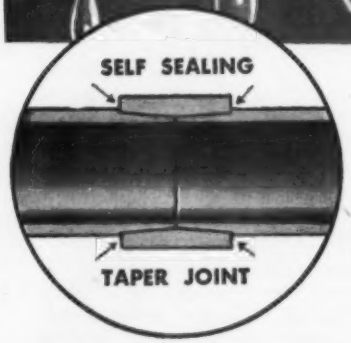
Company_____

Street_____

City_____ State_____

WATERTIGHT!





Orangeburg Fibre Conduit Prolongs Cable Life

Keep out corrosive ground waters, and you prolong the life of underground cables, say utility engineers!

Why? Because ground waters containing corrosive elements derived from the soil and concrete encasement attack cable sheath and shorten cable life. Orangeburg's impermeable wall and self-sealing Taper-Sleeve Joint shed them *"like water off a duck's back."* You get maximum protection with Orangeburg.

Orangeburg protects cables in many other ways. Smooth bore, low co-efficient of friction reduce incidence of abrasion. Its material is strong, tough, resilient, durable.

No other conduit is easier to install

Light, 8-foot lengths and a complete line of bends and fittings speed installation. Taper-Sleeve Joints tap water-tight in a jiffy. Orangeburg lays faster and at lower cost than any other type of conduit.

Orangeburg Fibre Conduit has prolonged cable life at minimum expense for utilities, municipalities and industry since 1893.

Distributed by Graybar Electric Company and by General Electric Supply Company. Branches and stocks in principal cities.



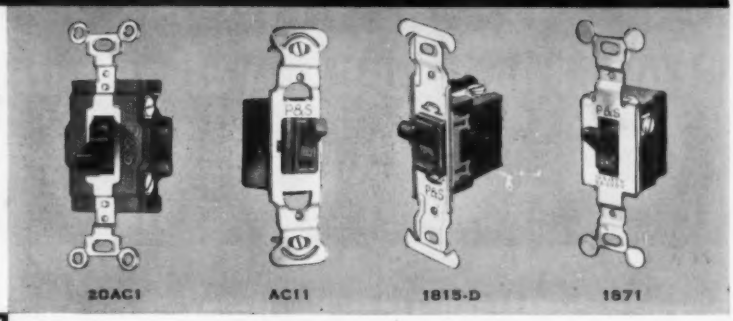
WRITE DEPT. EC-58 FOR CAT. 52

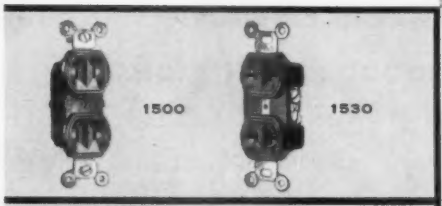
ORANGEBURG MANUFACTURING CO., INC., Orangeburg, N. Y. **West Coast Plant, Newark, Calif.**

ORANGEBURG®
FIBRE CONDUIT

THERE'S A P&S QUALITY WIRING DEVICE FOR EVERY REQUIREMENT

SWITCHES – A complete line . . . heavy duty 20 Amp AC . . . T-Rated . . . residential . . . a switch for every job.





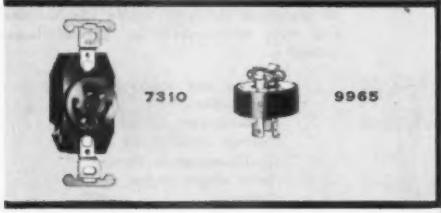
OUTLETS – A range to meet every need. Shown are the 1500 with time-saving screwless terminals and the 1530 T-Slot with dead back.



3-WIRE GROUNDING DEVICES—A full line of outlets, caps, connectors in 125 V and 250 V types.



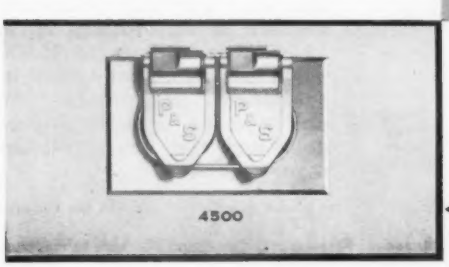
POLARIZED DEVICES— Available in 2, 3, and 4-wire . . . 15 and 20 Amps . . . outlets, caps and connectors . . . all built to take a beating.



TURNLOK – Sturdily built outlets, caps, connectors . . . 2, 3, and 4-wire, 10 and 20 Amps.

DESPARD LINE – The original and only complete interchangeable line . . . super-compact, highly versatile. Combinations assemble in seconds with P&S-Despard camstrap.





WEATHERPROOF COVER – Makes any standard duplex outlet a weatherproof device.

Standardize on Pass & Seymour Devices

PASS & SEYMOUR, INC.
SYRACUSE 9, NEW YORK
60 E. 42nd St., New York 17, N.Y. 1440 N. Pulaski Rd., Chicago 51, Ill.
In Canada: Renfrew Electric Limited, Renfrew, Ontario

TRANSFORMERS

To change higher voltage distribution service to lower voltage lighting and power circuits

SORGEL *Dry-Type* Transformers

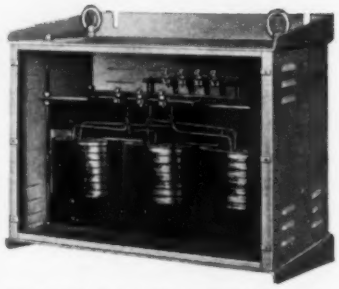
are the most practical type for indoor installations

SORGEL dry-type transformers can be installed at load centers, using higher voltage feeders, requiring smaller copper, increasing efficiency, improving voltage regulation and reducing wiring costs.

COST LESS TO INSTALL, because they are all self-contained in a single unit—either single phase or 3-phase—equipped with substantial wall brackets or floor mounting base. No separate brackets to make or buy. Easily accessible, roomy connection compartment. Solderless terminals.

QUIET OPERATION. All Sorgel dry-type transformers are so quiet that they can be installed in any convenient place in institutional, commercial and industrial buildings, thus assuring the most efficient distribution, best voltage regulation, and lowest wiring cost.

TYPICAL APPLICATIONS—Operate 120 volt lighting and portable equipment from 240, 480 or 600 volt power circuits.
For high voltage interior distribution systems of 2400, 4160, 4800, 7200, 13,200 and up to 15,000 volts.



50 Kva 3-phase, 480 to 208Y/120 volts. Wall mounting transformer. Connection compartment panel removed.

●

Complete line

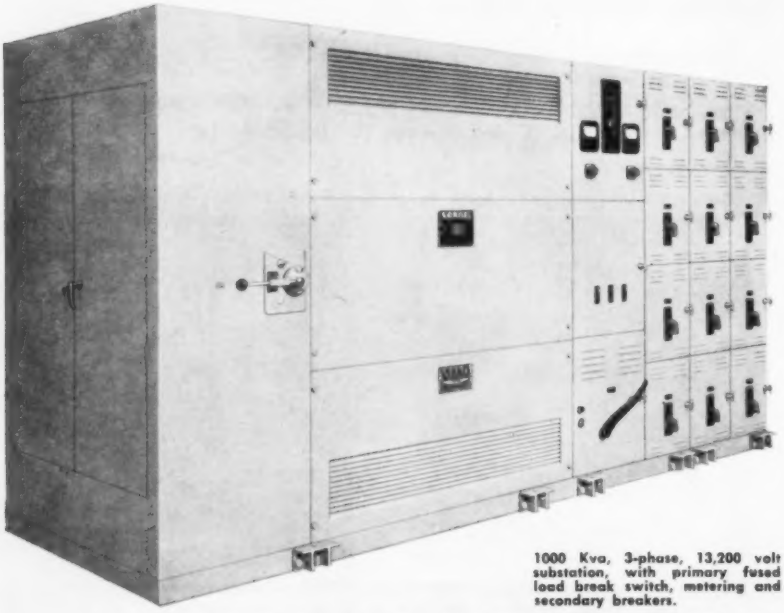
¼ Kva to 3333 Kva single phase.
1 Kva to 10,000 Kva 3-phase.
All standard voltages, 120 to 15,000 volts, and any intermediate or special lower voltage

Tested and approved by Underwriters' Laboratories on all ratings covered by the Re-Examination Service, both single phase and 3-phase.

●

Also special transformers and saturable reactors

●



1000 Kva, 3-phase, 13,200 volt substation, with primary fused load break switch, metering and secondary breakers.

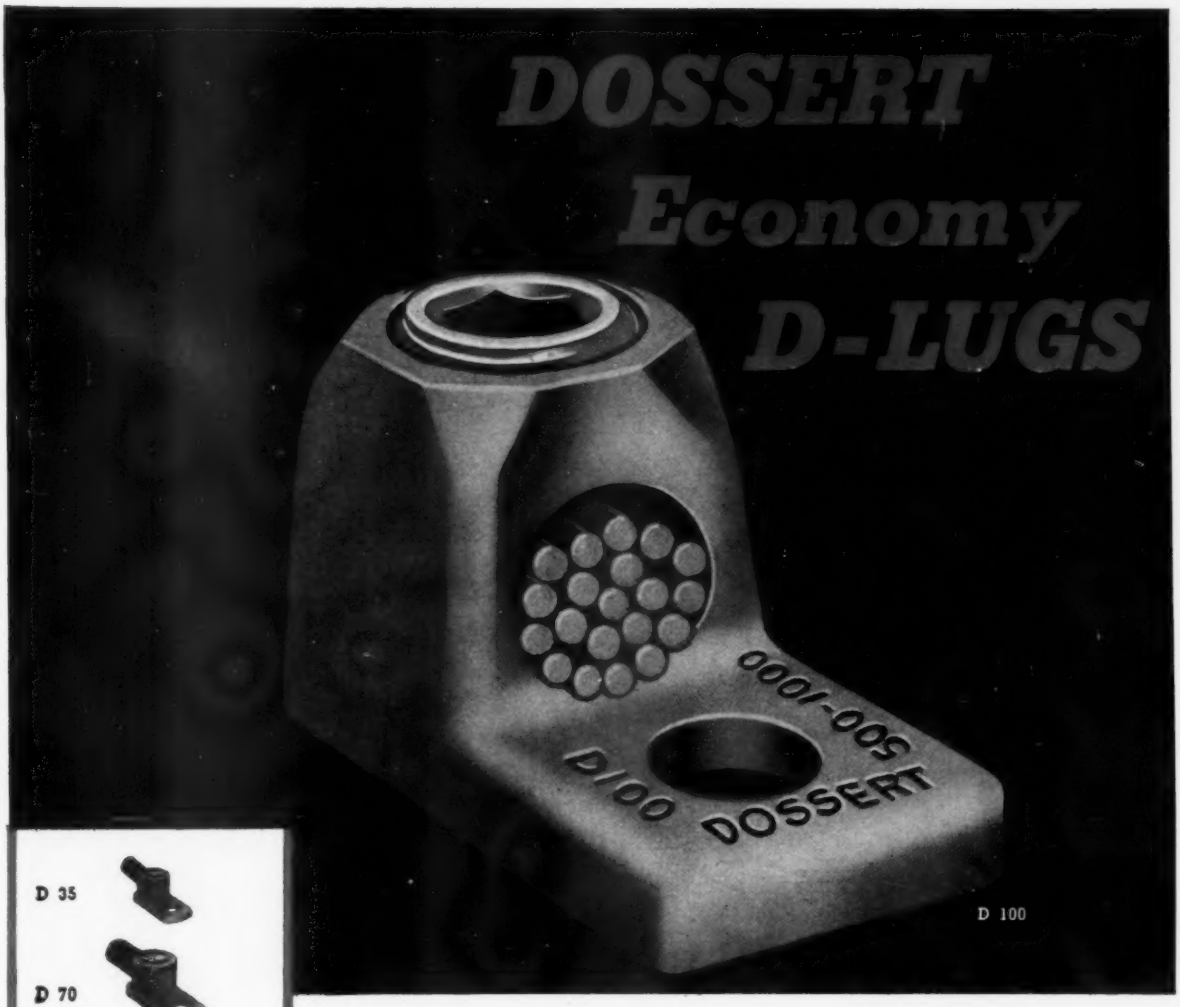
Substation transformers

The same quiet SORGEL transformers, in ALL ratings up to 10,000 Kva and up to 15,000 volts, are also incorporated in substations. Procurable with any type or make of switchgear, and from any substation manufacturer.

Sales Engineers in Principal Cities. Consult the classified section of your phone directory or write to the factory.

SORGEL ELECTRIC CO., 836 West National Avenue, Milwaukee 4, Wisconsin

DOSSERT Economy D-LUGS





Here is a complete and low-priced line of D-LUGS. These connectors are more compact and heavier in weight to insure cooler operation under more severe loads, while being much easier to install. Only seven sizes accommodate from 14 SOL. to 1,000,000 CM.

FEATURES:

- **Rugged construction**
- **Made of high conductivity copper alloy**
- **Suitable for all purposes**
- **Variable, each connector takes wide range**
- **Exceptionally compact**
- **Reusable**

Write for detailed information and prices!

50 YEARS OF TECHNICAL KNOW-HOW

DOSSERT MFG. CORP.

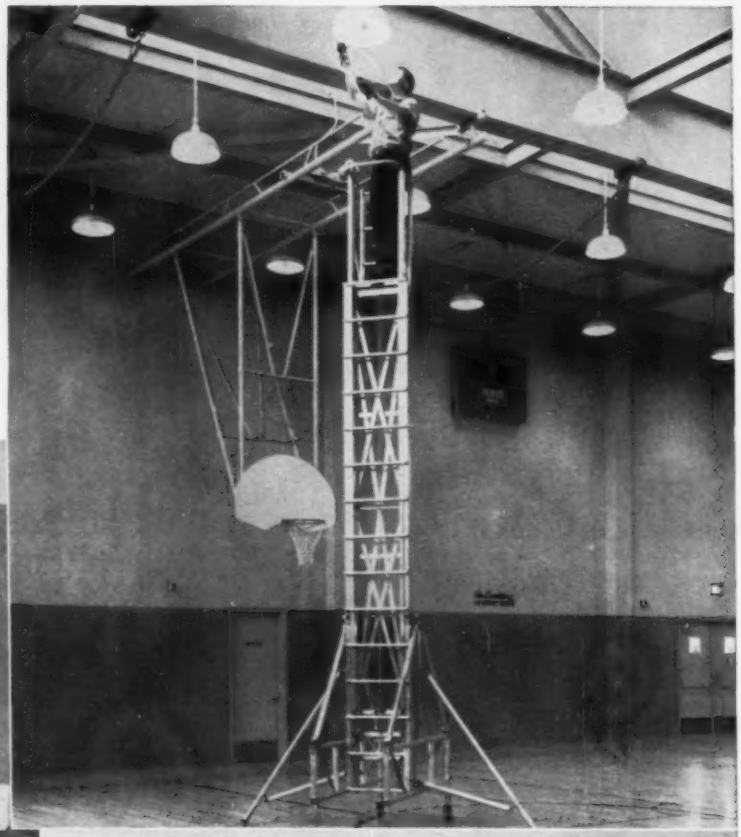
249 Huron Street, Brooklyn 22, N. Y. Representatives in all principal cities

IN CANADA: W. S. Gerrie & Assoc., Ltd., Toronto

UP-RIGHT ANNOUNCES

TALLESCOPE ...telescoping aluminum work platform for overhead construction and spot maintenance

Lightweight, rapidly assembled by one man. Extends instantly for reaching heights up to 30 ft. Telescopes for rolling under trusses and other obstacles. Adjustable legs for uneven floors or stairways.









Rolls through doorways . . . only 29" wide, telescopes and folds down.

Bridges over auditorium seats.

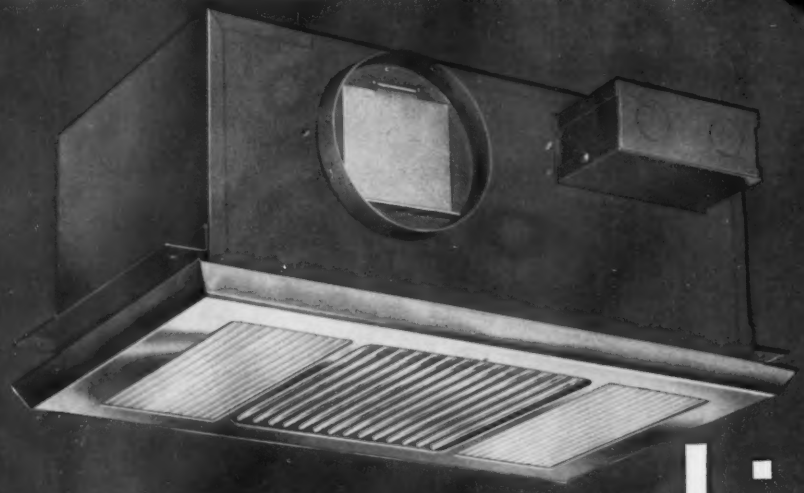
Separates easily into 3 components for convenient storage or transportation.



FOR TALLESCOPE CIRCULAR
WRITE TO
UP-RIGHT SCAFFOLDS
DEPT. 177 • 1013 PARDEE ST., BERKELEY, CALIF.

MANUFACTURED BY
UP-RIGHT
SCAFFOLDS

NEW!... the latest in the Slim Trim LOOK from FASCO



VENTILATOR Light

... for bath and utility room ... quick and economical to install ... modern design

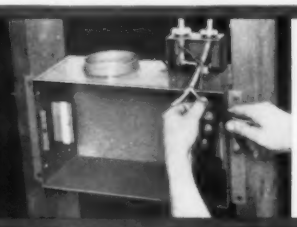
This is the new kind of design that has the builder and contractor in mind. Fasco has engineered this new ventilator-light to save you time in installation ... and time means money. The photos below show how simple it is to install and the many step saving features.

Powerful ventilator and soft, ample light from two sixty watt bulbs in a sleek Slim Trim design make this a handsome unit that will enhance any job.

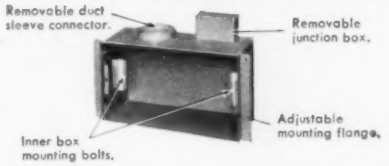
Color catalog and installation piece is yours for the asking. Fill out the coupon below and mail today.



1



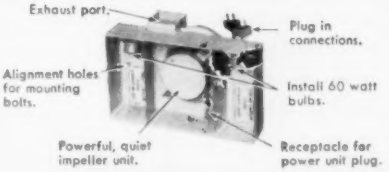
Rough-in box fits 16" O. C. joists and is attached by the adjustable mounting flange or directly to joists. Remove junction box cover, or for existing work the complete box is removed from inside. Rough wiring connections are all that is necessary. Slip duct on removable duct sleeve. Flanges are pre-set ¾" for standard plaster thickness.



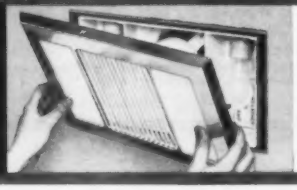
2



After plaster or dry wall, box can be raised or lowered on mounting flange to fit flush. On existing ceilings, mounting flanges are reversed with long lip against box so short side will lie flush with ceiling plaster. Inner box complete with power unit then slips quickly into place.



3



Line up mounting stud on grille with holes in rough-in box and just push. The grille flange is wide enough to cover imperfections in ceiling hole. The exclusive "snap-in" grille can be removed for cleaning and bulb replacement simply by pulling from unit.



Please send me full information on Ventilator light 655-C

FASCO INDUSTRIES, INCORPORATED, 126 AUGUSTA ST., ROCHESTER 2, N. Y.

FASCO

ECM-558

▼ NAME ▼ ADDRESS ▼ CITY ▼ ZONE ▼ STATE



Yes, Bowling Alleys Too Can Get Striking Lighting with Standard Fixtures . . . by LITECONTROL

In these pages over the years we have been pleased to show you lighting installations in banks, offices, Supermarkets, specialty stores, schools and gymnasiums, churches, libraries and industrial plants. All of these installations have one thing in common — the superb quality of the lighting is obtained with *moderate in cost, standard fixtures* — right out of our catalog.

The same circumstances prevail with this ultra-modern bowling alley. It is an impressive establishment — with sixty continually busy alleys, a modern restaurant and snack bar and air-conditioning. Litecontrol fixtures were chosen to illuminate this handsome interior and to blend into this very well designed structure. They were used throughout except for the area immediately over the alleys.

Whether *your* next installation is a bowling alley or a bank, you can get results on a sensible budget with LITECONTROL.

INSTALLATION:
Thruway Lanes, Buffalo, N. Y.

AREA: Bowling Alley

ARCHITECT: Milton Milstein

ENGINEER: Walter H. Sherry & Associates

DISTRIBUTOR:
Buffalo Incandescent Light Co., Inc., Buffalo, N. Y.

ELECTRICAL CONTRACTOR:
Frey Electric Construction Co.

FIXTURES:
Litecontrol No. 6042TS 4-lamp approx. 2′ x 2′ recessed fixtures; No. 3324RS and 3428 2-lamp recessed fixtures. 2-lamp, 8-ft. strip fixtures over alleys by others.

FIXTURE SPACING: 11 feet on centers

INTENSITY:
Average 45 foot-candles after 6 months operation (alley area not included)

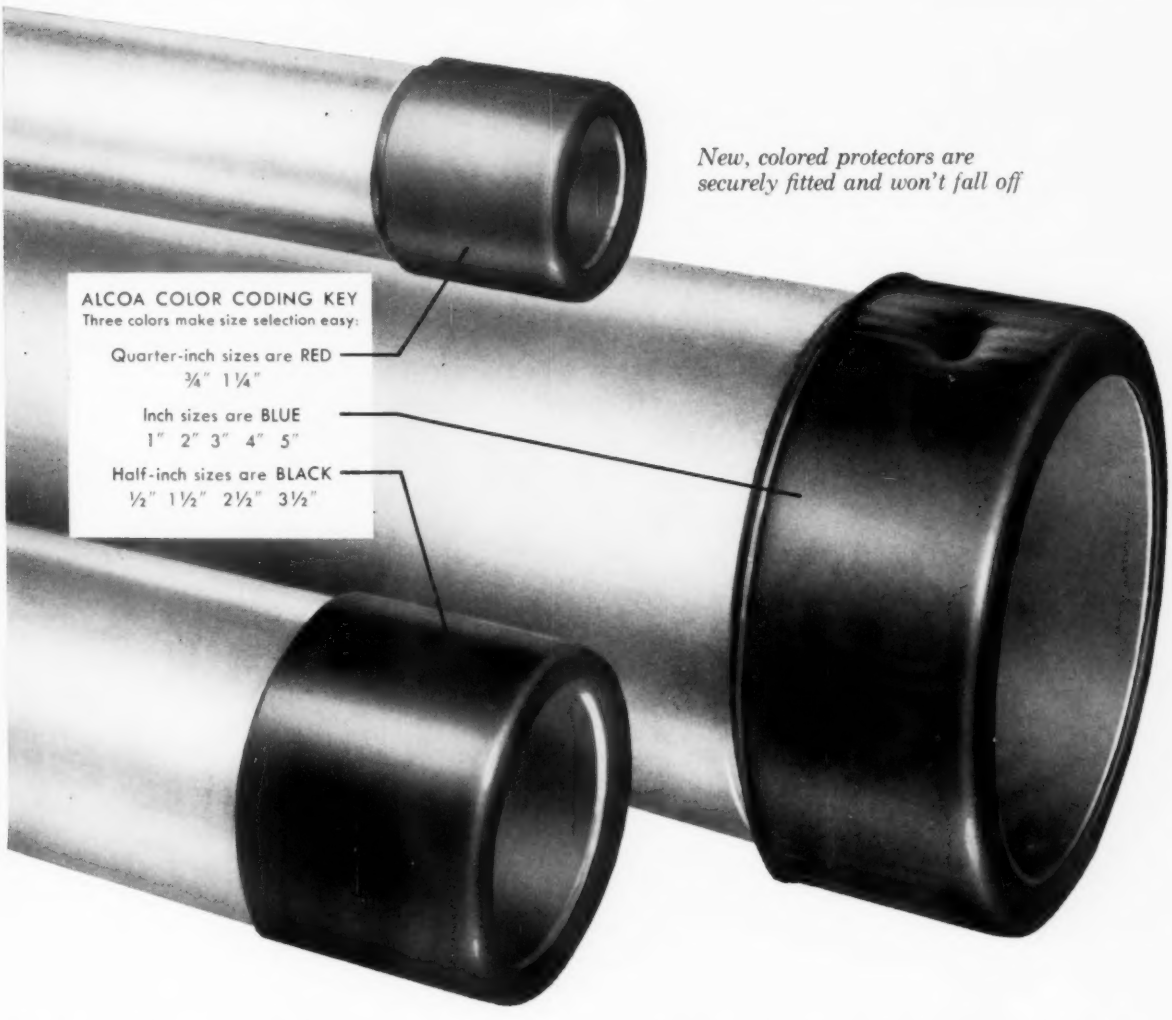
LITECONTROL *Fixtures*

KEEP UPKEEP DOWN

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

NOW! COLOR CODING ON ALCOA RIGID CONDUIT SIMPLIFIES SIZE SELECTION AND STOCKING



New, colored protectors are securely fitted and won't fall off

Thread protectors on Alcoa® Aluminum Electrical Rigid Conduit are brightly colored to help you tell size at a glance.

These all-new thread protectors are made to stand up under rough handling in the warehouse or on the job. They spell an end to guesswork and time-consuming mistakes in conduit selection.

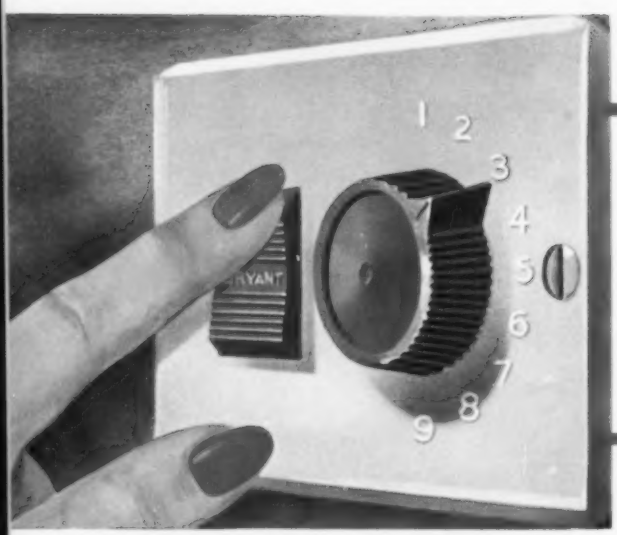
With new low prices, Alcoa Aluminum Rigid Conduit is today's most economical buy. Its light weight reduces installation costs. It is nonsparking and nonmagnetic. Excellent corrosion resistance eliminates painting, reduces maintenance and extends life. Find out why Alcoa Aluminum is *your* best conduit buy. Contact your Alcoa Conduit distributor or write Aluminum Company of America, 2327-E Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM CONDUIT
ALUMINUM COMPANY OF AMERICA

Underwriters' Laboratories, Inc. INSPECTED
RIGID CONDUIT
ISSUE MU-28

Your Guide to the Best in Aluminum Value

"ALCOA THEATRE"
Exciting Adventure
ALTERNATE MONDAY EVENINGS



EASY TO INSTALL

revolutionary low-voltage BRYANT

brings you satisfied customers and extra profits

Multi-Control is easy to install. It puts more money into your pocket because it takes no longer to install than ordinary wiring systems. Contractors are making $25 to $75 extra profit installing Multi-Control in a home—and their customers are delighted with the results.

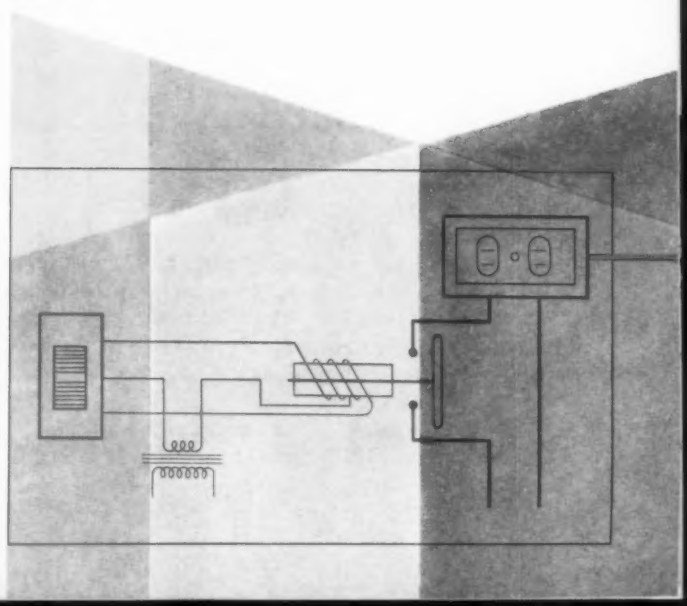
Multi-Control adds new convenience to electrical living. It's the most modern means of controlling lighting and appliance loads. Master Selector Switches permit control of numerous circuits from any point. Additional switches may be added as needed.

Your customers will take pride in owning this system . . . saves steps, saves time and makes for easy living.

On your next job, suggest Multi-Control. Once your customer understands what it is, he'll want it.

It's easy to sell—it's easy to install.

BRYANT THE **BRYANT** ELECTRIC COMPANY
BRIDGEPORT 2, CONN. • CHICAGO • LOS ANGELES



how low-voltage Multi-Control system works

A. Transformer supplies 24-volt current.

B. Relay controls 125-volt current at outlet.

C. Pushbutton switch (momentary contact) controls relay, thus outlet.

D. Standard duplex convenience outlet.

MULTI-CONTROL



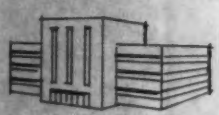
In the Home—controls desired outlets in every room in house, garage and grounds.



Commercial and Industrial Uses—controls lighting power and machinery at one or more central locations.



In Schools—controls hall and classroom lighting with lock-out circuit. Only the master's station retains control until lock out is released.



For Hospitals and Institutions—required by public buildings where control of lighting must be under strict supervision.



Make Bull Dog your Pet Tape!



There's a
BULL DOG TAPE
for every purpose

- **FRICTION**
- **RUBBER**
- **PLASTIC**

BULL DOG TAPE is a man's best friend! Delivers thoroughbred performance every time. It goes on fast . . . sticks tight and stays tight. Splices neatly . . . extra strong and non-ravelling. High dielectric strength for complete all-around electrical protection. BULL DOG is *tough*, too . . . resists weather and moisture . . . stands up longer on the job!

Sold only through verified wholesalers

Another quality product of

BOSTON BOSTON WOVEN HOSE & RUBBER COMPANY
BOSTON 3, MASSACHUSETTS

Also manufacturers of Garden Hose · Nozzles · Matting · Stair Treads

I'VE GOT

"NO PRICE WORRY...

WHEN I BUY

ETP QUALITY

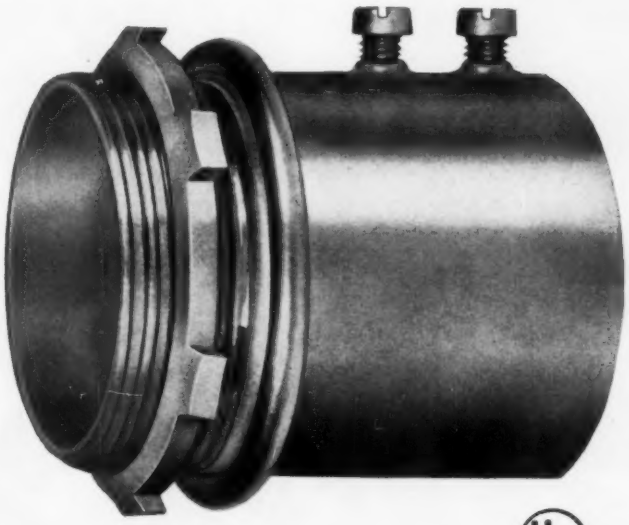
FITTINGS"



E.T.P. *always* takes care of me on price and quality! As a supplier, they've certainly earned my confidence—and the confidence of my customers. I know their price is *consistently competitive*—their connectors and couplings *consistently superior. I like doing business with E.T.P.*

ETP FITTINGS OFFER ALL THESE EXCLUSIVE ADVANTAGES:

- Exclusive Pre-Set, Deep-Slotted Staked Screws. No backing out for conduit.
- Concrete tight! Far surpasses U.L. requirements. U.L. File Card E24708.
- Precision beveled edges with new, extra heavy duty precision locknut.
- One piece solid tubular steel —cannot open or spread. Sized for uniformity.
- Lustrous zinc, heavy plated finish with heaviest gauge wall thickness.
- Available in ½", ¾", 1", 1¼" (one screw type) and new 1½" and 2" sizes (two screw type).

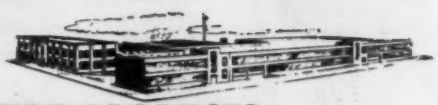


UL

CONNECT WITH ETP FOR ECONOMY

ETP

Write for free samples and brochure



ELECTRIC TUBE PRODUCTS

74-16 Grand Avenue, Maspeth (N.Y.C.), N. Y. Defender 5-8000

you get EXTRA PROTECTION
plus Extra Economy with
ECONOMY FUSES



Economy Fuses give you Extra Protection with such built-in superiorities as:

Specially Developed Metal Alloys
These alloys, because they are developed to meet specific requirements, assure "quick as a wink" action when the danger point is reached. Yet they also assure extra protection against needless fuse blows due to sudden power surges or current fluctuations.

In addition to this extra protection, Economy brings you the extra advantage of a

Complete Line of Fuses
Nearly 400 types, sizes and capacities enable you to select exactly the right fuses, specially engineered to best meet your requirements.

Extra Protection *plus* Complete Line Selection add up to extra economies such as:

- Reduced fuse replacement costs
- Fewer repairs
- Longer life for electrical equipment
- Reduction of work stoppages due to fuse blows

NEARLY 400 TYPES, SIZES AND CAPACITIES

ECO® ONE-TIME CARTRIDGE FUSES
Knife blade and ferrule types, sizes from 2" to 13¾" and up to 600 amps for both 250 and 600 volts.

ARKLESS® MECHANICAL INDICATING FUSES
Knife blade or ferrule types, sizes from 2" to 13¾"; up to 600 amps in both 250 and 600 volts.

DELAY® RENEWABLE CARTRIDGE FUSES
Knife blade or ferrule types, sizes from 2" to 13¾"; to 600 amps, 250 volts and 600 volts.

ECONOMY RENEWABLE PLUG FUSES
Available in standard and sub-standard sizes; from 10 to 30 amps for 125 volts.

CLEARSITE® PLUG FUSES
Available in both standard and sub-standard sizes; from 1 to 30 amps.

ECON® DUAL-ELEMENT CARTRIDGE FUSES
Knife blade and ferrule types; from 0 to 600 amps, 250 and 600 volts.

ECONOMY FUSTATS
Resist tampering and over-fusing. Available from 1 to 30 amps.

ECONOMY FUSE PULLERS
Treated and sealed to minimize moisture absorption. Withstand breakdown test of 35,000 volts dry.

ECONOMY CLIP-TITE
Positive protection insures tight electrical contacts of fuse clips. Prevents heating of contacts.

Economy Trade Name fuses carry full Underwriters' Laboratories approval and listing.

ask your Electrical Wholesaler for Economy Fuses

SEND TODAY *for your FREE Economy Fuse Folder No. 3. This handy size folder lists the nearly 400 sizes, types and capacities of fuses available.*

ECONOMY FUSES FOR EVERY PURPOSE

150

ECONOMY FUSE & MFG. CO., 2717 Greenview Ave., Chicago 14, Ill.



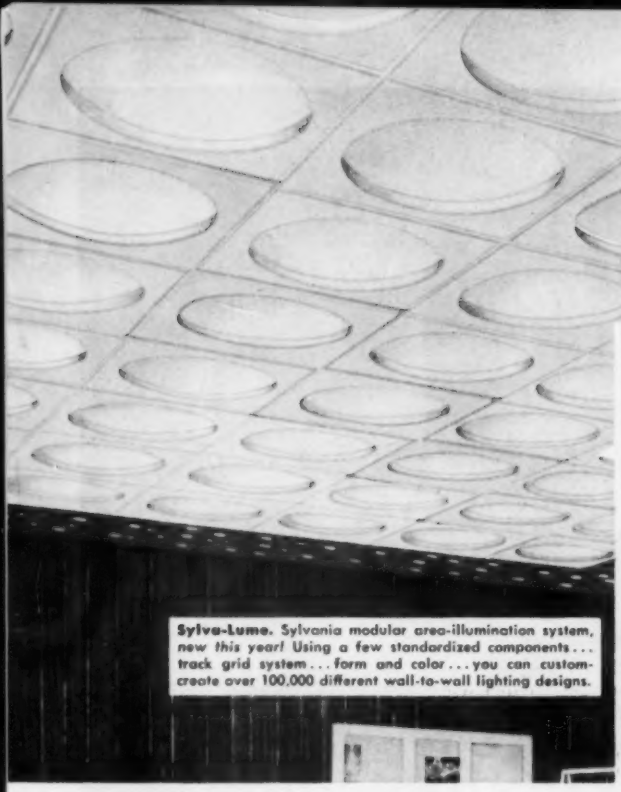
THAT'S WHY PITTSBURGH STANDARD'S HOT-DIP GALVANIZED THREADS SAVE YOU MONEY

The cost of labor must be figured into the original cost of conduit if you have to pay workmen to chase conduit threads which have rusted in your storage. That's why Pittsburgh Standard's Hot-Dip Galvanized Conduit with *hot-dip galvanized threads* is the least expensive conduit . . . threads just can't get rusty. This happy result is made possible by the world's most modern conduit mill, Pittsburgh Standard's Morrisville plant. The process developed at Morrisville has now been extended to cover Etna production on all sizes through 6 inches. You can get shipping and price information by writing or calling your nearest Pittsburgh Standard wholesaler or *Pittsburgh Standard Conduit Co., 61 Bridge Street, Pittsburgh 23, Pa.*

PITTSBURGH STANDARD CONDUIT CO.

PLANTS AT MORRISVILLE & ETNA, PA.

RIGID STEEL CONDUIT • ELECTRICAL METALLIC TUBING • ELBOWS • COUPLINGS • FITTINGS



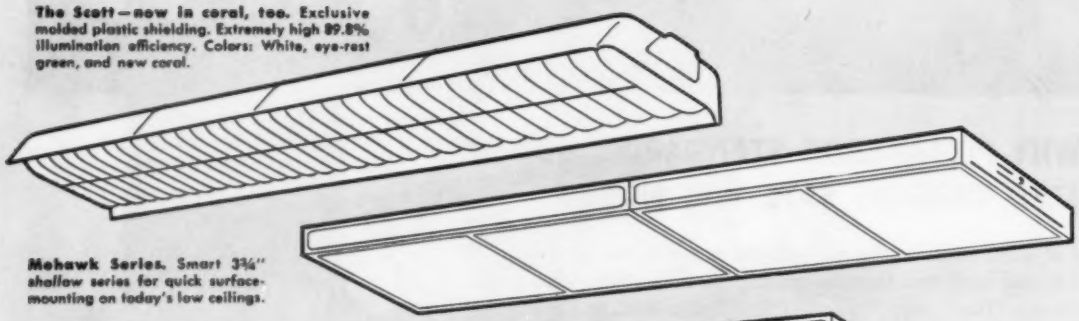
Sylva-Lume. Sylvania modular area-illumination system, *new this year!* Using a few standardized components... track grid system... form and color... you can custom-create over 100,000 different wall-to-wall lighting designs.



Sylvan-Aire. Sylvania linear system for area illumination. Rows of white corrugated plastic provide soft, *diffused* light... high foot-candle levels with minimum of shadow and glare. Plastic rolls out easily for maintenance.

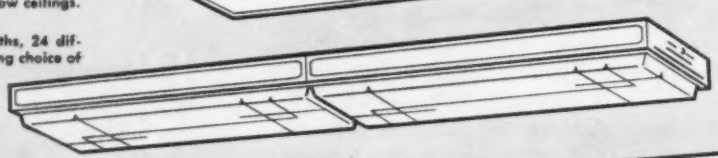
Your FULL line of featured

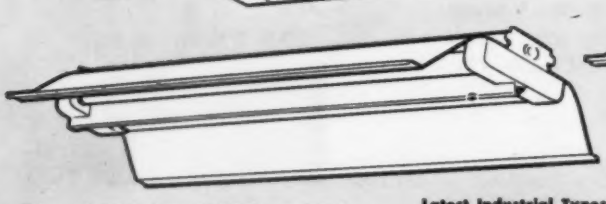
The Scott—now in coral, too. Exclusive molded plastic shielding. Extremely high 89.8% illumination efficiency. Colors: White, eye-rest green, and new coral.



Mohawk Series. Smart 3¼" *shallow* series for quick surface-mounting on today's low ceilings.

One- and 2-foot widths, 24 different stylings including choice of shielding.





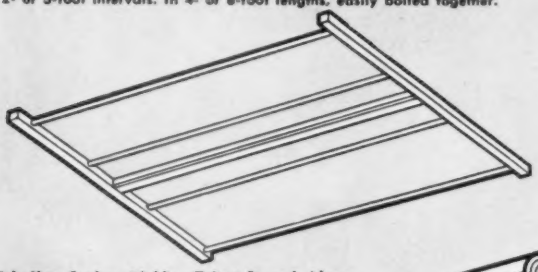
Diamond-"I" Series with 25% upward light

Latest Industrial Types. Meet or exceed RLM specs for plant lighting with increased upward light components.

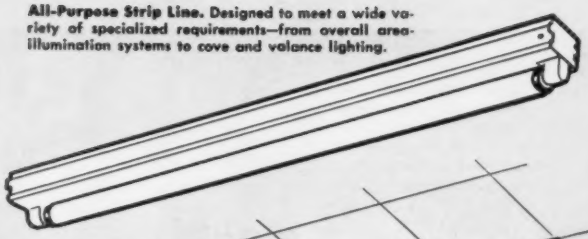


NTW5 Series with 10% upward light

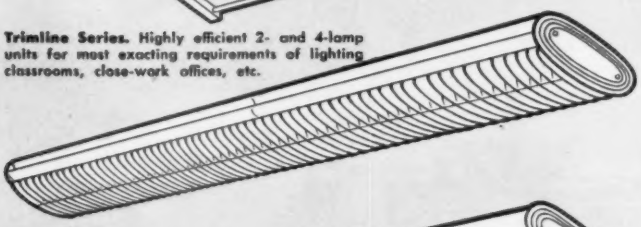
New "Outrigger" Fixture. Great timesaver and economical short cut for wall-to-wall lighting. Combines several lamps, spaced, on one unit. Available in 2-, 3- or 4-lamp styles—with lamps spaced at 2- or 3-foot intervals. In 4- or 8-foot lengths, easily bolted together.

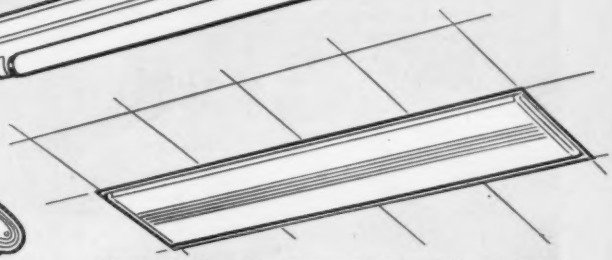


All-Purpose Strip Line. Designed to meet a wide variety of specialized requirements—from overall area-illumination systems to cove and valance lighting.

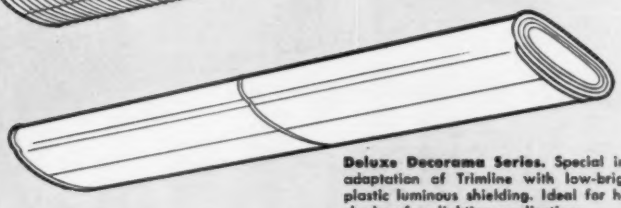


Trimline Series. Highly efficient 2- and 4-lamp units for most exacting requirements of lighting classrooms, close-work offices, etc.

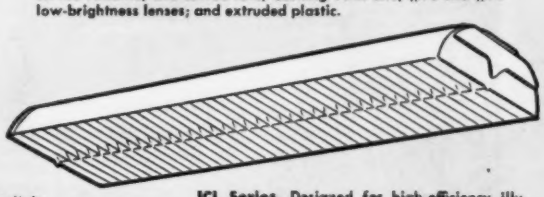




Sylvania Troffers. Classic recessed lighting. Wide selection of shielding: 45° x 45° louvers, Corning flat-ribbed Albalite glass, curved Albalite, and curved lens; Corning Twin-Lite, #70 and #72 low-brightness lenses; and extruded plastic.



Deluxe Decorama Series. Special indirect-light adaptation of Trimline with low-brightness all-plastic luminous shielding. Ideal for high-quality, shadow-free lighting applications.



ICL Series. Designed for high-efficiency illumination with a strong downward component. Distribution is 40% upward light, 60% downward light.

SYLVANIA

Lighting Systems and Fixtures

blazing a long, long trail of product advantages

. . . to spur your sales

Every time you install a Sylvania Lighting System or Fixture, it speaks well for you . . . *sells* for you. You can depend on it to look and perform the way discriminating customers expect it to. It will label your work as true craftsmanship.

Shown on these pages are several modern lighting systems and fixtures—the *featured* Sylvania line. Here are lighting ideas, new thinking, modern aesthetic designs. And here is the finest lighting performance that money can buy, both in quantity and quality of light delivered.

Sell Sylvania—and link your name to the finest brand in lighting.

. . . to chop your costs

Sylvania's real payoff for you: precious man-hour savings on the job with fewer call-backs after the installation is completed.

Safe labor-saving devices are traditionally Sylvania's star attraction. Some are built in, some come as optional or low-cost accessories. The many man-hours saved are your assurance of substantial profits and greater leeway for job-winning bids.

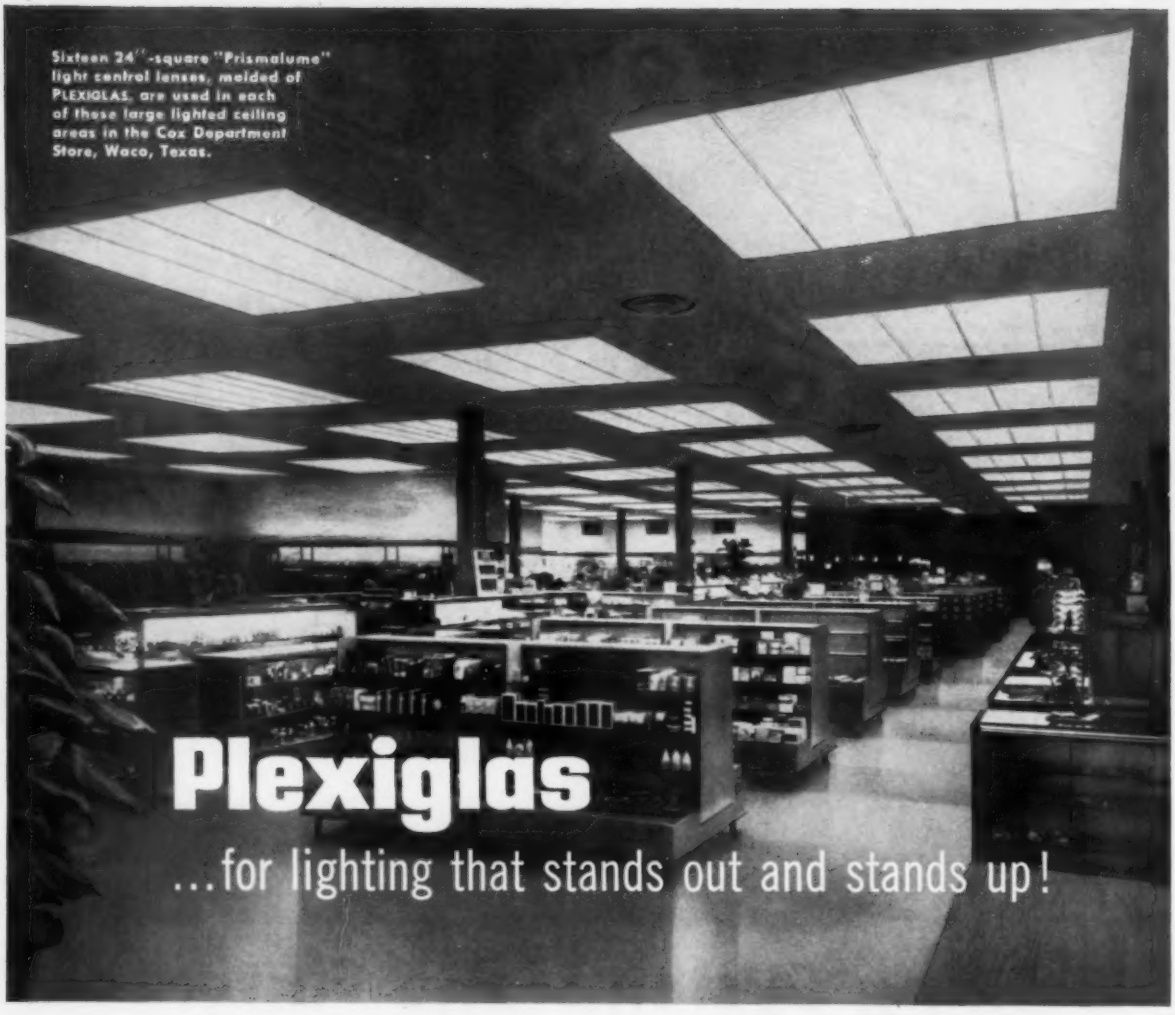
We suggest you look over the few Sylvania Fixtures and Systems shown here. Then ask your Sylvania Fixture Specialist or Select Distributor for full details. Write direct for complete catalog and the name of your nearest distributor.

SYLVANIA

. . . fastest growing name in sight

SYLVANIA ELECTRIC PRODUCTS INC.
Dept. E-40, Lighting Division—Fixtures
One 48th Street, Wheeling, W. Va.

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY



When a store and its merchandise appear in a good light, the result is more sales. PLEXIGLAS® acrylic plastic gives highest efficiency in transmission of light . . . yet has low surface brightness that reduces reflections and distractions. It is clean and attractive . . . enhances the most modern interiors. And PLEXIGLAS is strong and durable, resists breakage and discoloration, can be handled and cleaned easily. We'll be glad to furnish names of companies who manufacture lighting equipment that includes PLEXIGLAS lenses or diffusers.

Chemicals for Industry

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

Canadian Distributor: *Crystal Glass & Plastics, Ltd., 130 Queen's Quay East, Toronto, Ontario, Canada.*



LIGHT CONTROL LENSES —molded of clear PLEXIGLAS, provide a high level of prismatically controlled light with complete visual comfort, plus beauty and safety overhead. Light in weight. Can be mounted in multiples to form large luminous areas.



PAN-TYPE DIFFUSERS —formed of white translucent PLEXIGLAS, provide low surface brightness, reduction of shadows and soft overall diffused lighting.

NEAT, NATURAL and NECESSARY

NARRAGANSETT'S NEW

PULL-REEL

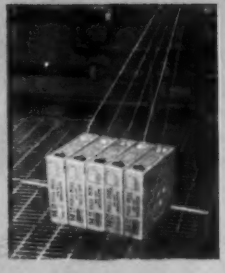
THE "NEW" AND "ONLY" STRAIGHT-FEED, NO-TWIST, NO-KINK, REELED WIRE PACKAGE . . .



Here's the newest, fastest and safest way to install wire. Compare the old style center coiled wire against straight reeled wire in a carton. Straight, Pull-Reel wire assures easy conduit pulls, avoids dangerous sleeving due to kinks and twists, avoids waste on short pulls and it follows you easily all over the job.

Consider the savings! Pull-Reel's unique finger plugs allow rewind of wire at cut off time and the self braking action of the reel prevents aggravating overspins. These factors greatly reduce your scrap loss. Time loss is reduced materially. By inserting ½" thin wall through the corner knockout plugs you can carry, anchor, or set up a battery of Pull-Reel cartons in colors. These are just a few features of the Pull-Reel.

Send today for our free illustrated brochure that shows the many ways Pull-Reel can assist you. **SPECIFY NARRAGANSETT PULL-REEL** on your next job.



Batteries of 2, 3, 5 or more colors always feed straight with no bulky twisting, stripping or replacing.



Easily anchored in either new construction or rewiring jobs. Simply drop the Pull-Reel carton behind any stud and walk away with your Narax cable.



Knock out holes in carton allow circuit sizes of Narawire to be easily handled and carried by a scrap length of ½" thinwall.

OFFERED EXCLUSIVELY BY THE

NARRAGANSETT WIRE COMPANY

MILLS: PAWTUCKET, R. I. — TAUNTON, MASS.
PLANO, TEXAS — ORANGE, CALIF.

"Where Integrity in Wire is Known and Recognized"

Narragansett produces "NARAWIRE" types TW, RHW, RH-RW and NARAX types NM, NMC, and UF (Non-Metallic Sheathed Cable) in new Pull-Reel packages which are available only through Narragansett Franchised Distributors.

"PULL-REEL" is a registered trade mark.
"PULL-REEL" is patented.



Along today's modern highways easy-to-handle J-M Transite Ducts provide installation economies and years of service life, protecting traffic-signal, lighting, and other power-service circuits.

J-M Transite® Ducts install fast to last... give complete cable protection.

Because speed and economy set the pace in today's highway programs, more and more highway cables are going into Johns-Manville Transite Ducts.

For speed, Johns-Manville Transite Ducts are strong, light and long—easy to handle and install. Workmen set 10-foot lengths in place easily, join them up tight in seconds with snug-fitting J-M Plastic Couplings, and Transite's smooth bore is free of burrs and other obstructions that may interfere or cause damage during pulling of cables.

For economy, J-M asbestos-cement Transite Ducts go in to stay. Non-conductive Transite is not affected by electrolysis—resists the corrosive action of fills or high-salt soils in permanently damp locations. Millions of feet of installed Transite Ducts have proved that Transite withstands earth loads and soil stress... resists vibration and shock from highway traffic.

Let us send you free Transite Duct brochure EL-29A. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS



Johns-Manville Asbestos Transite Ducts can be laid directly in trench without concrete envelope or other mechanical protection.

JOHNS-MANVILLE Transite Ducts

Made of Asbestos-Cement

J-M Conduit for direct buried banks and exposed runs
J-M Korduct® for concrete banks



GET GOLD SEAL RUBBER TAPE *for easy handling and instant fusing*

Here's the tape for high voltage insulation! Easy to work with, Gold Seal Rubber Tape fuses together instantly, provides long-life insulation protection. With its high dielectric strength and ability to conform to irregular shapes, Gold Seal makes a perfect insulating splice. Jenkins Bros., Rubber Division, 100 Park Avenue, New York 17.



Gold Seal Tape

FOR EVERY APPLICATION

Gold Seal Friction • RUBBER • Plastic Tapes . . .

Commercial and Specification Grades



In 10-roll containers or single rolls. Each roll sealed in cellophane, stays fresh.

SELECTOR GUIDE

Sierra SPECIFICATION GRADE WIRING DEVICES

SILENT MERCURY SWITCHES

TOP OR BACK WIRED

No moving blades or springs to fail. Each switch individually tested to assure perfect performance. Exclusive Sierra feature permits top or back wiring. Red identification stripe for proper mounting.

Sierra Mercury Switches are the only Specification Grade, Top or Back Wired, switches available.



5001 5002 5003



RATINGS	125V. "T"	250V.	125V. AC
	10 AMP.	5 AMP.	15 AMP.

SPECIFICATION GRADE	DESCRIPTION	TOGGLE IVORY	TOGGLE BROWN
	Single Pole	5001	5001X
	Double Pole	5002	5002X
	Three-Way	5003	5003X
	Four-Way	5004	5004X

SIERRAPLEX

SIERRAPLEX is a registered trade name for a new line of distinctively designed receptacles. Clean and modern, they complement any decor—and are built only to the exacting Specification Grade standards, your visual proof that only the finest has been installed.



1800 1600 1801 1601 1702 1900 1703 1503



DESCRIPTION	PARALLEL SLOTS 15A-125V IVORY	PARALLEL SLOTS 15A-125V BROWN	TANDEM SLOTS 15A-250V IVORY	TANDEM SLOTS 15A-250V BROWN
BACK AND SIDE WIRED				
Single Grounding-Type 3-wire	1600	1600X	1601	1601X
Duplex Grounding-Type 3-wire	1800	1800X	1801	1801X
Duplex Grounding-Type Comb. 2- and 3-wire, 15A 125V-250V			1850	1850X
Single Convenience 2-wire	1500	1500X	1501	1501X
Duplex Convenience 2-wire	1700	1700X	1701	1701X
SIDE WIRED				
Single Grounding-Type 3-wire	1602	1602X	1603	1603X
Duplex Grounding-Type 3-wire	1802	1802X	1803	1803X
Duplex Grounding-Type Comb. 2- and 3-wire, 15A 125V-250V			1852	1852X
Single Convenience 2-wire	1502	1502X	1503	1503X
Duplex Convenience 2-wire	1702	1702X	1703	1703X
Triplex—Single Circuit	1900	1900X	—	—
Triplex—2 Feeds—1 Return	1901	1901X	—	—
Triplex—2 Feeds—2 Returns	1902	1902X	—	—

SIERRA

SIERRA receptacles offer the same high quality and craftsmanship as the Sierraplex line. All are Specification Grade, with smooth conventional styling.



1400 1200 1401 1201 1302 1102 1303 1103

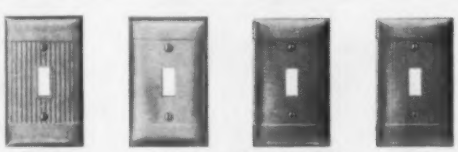


BACK AND SIDE WIRED				
Single Grounding-Type 3-wire	1200	1200X	1201	1201X
Duplex Grounding-Type 3-wire	1400	1400X	1401	1401X
Duplex Grounding-Type Comb. 2- and 3-wire, 15A 125V-250V			1450	1450X
Single Convenience 2-wire	1100	1100X	1101	1101X
Duplex Convenience 2-wire	1300	1300X	1301	1301X
SIDE WIRED				
Single Grounding-Type 3-wire	1202	1202X	1203	1203X
Duplex Grounding-Type 3-wire	1402	1402X	1403	1403X
Duplex Grounding-Type Comb. 2- and 3-wire, 15A 125V-250V			1452	1452X
Single Convenience 2-wire	1102	1102X	1103	1103X
Duplex Convenience 2-wire	1302	1302X	1303	1303X

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OVER 70 YEARS EXPERIENCE

Insulated Wires and Cables

Pictured and described here are just a few of the many wires and cables that are made by CRESCENT.



ABC ARMORED CABLE

Has prefabricated breaking lines which make installing easier, quicker and safer. A flattened bonding wire in contact with the underside of each convolution of the armor assures a permanent low resistance of armor.



SYNTHOL BUILDING WIRE — TYPE TW

For both wet and dry locations. Insulated with a special, tough thermoplastic compound. High dielectric and mechanical strength. Smallest outside diameter for same conductor size permits more or larger conductors in same space.



ENDURITE BUILDING WIRE — TYPE RH-RW

A dual purpose wire, for either dry or wet locations. Type RH has a greater carrying capacity because of higher permissible operating temperature, which allows use of smaller size cable at less cost.



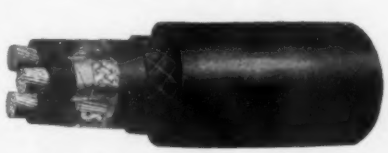
IMPERVEX TRENCHWIRE — TYPE USE-RR

Single conductors for direct earth burial. Has a heavy Neoprene jacket over the rubber insulation. Provides low cost, permanent underground cable installation.



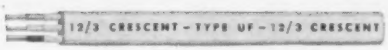
STEEL TAPED PARKWAY CABLE

Designed for direct earth installation without additional protection. All standard types regularly supplied and special type cables made to customers' specifications.



IMPERIAL PORTABLE POWER CABLE

Illustration shows Type SH-D 5000 Volt Trailing Cable for supplying power to electric shovels, dredges, etc. Covered with extremely tough Neoprene jacket.



TYPE UF AND TYPE NMC

Used for direct earth burial as an underground feeder, also used for branch circuit wiring in damp or corrosive locations.



BUILDING WIRE — TYPE RHW

Braid or Neoprene covered

Highest quality insulation, for use in both WET and DRY locations at 75° C.



CRESFLEX

Most suitable, lowest cost for rural, residential and farm buildings. Clean, gray paint finish.



SERVICE CABLES — TYPE SE

Both Style A (armored) and Style U (unarmored) are approved by Underwriters' Laboratories as service entrance cable and may be run down the side of a building without additional protection. It is tamper-proof, flexible and lightweight, moisture-resistant and flame-retarding.



NEOPRENE CRESCORD

Heavy duty, oil-proof portable cord, Underwriters' Laboratories Type SO.



INTERLOCKED ARMOR POWER CABLE

Provides a flexible, metal-enclosed method of wiring for power.

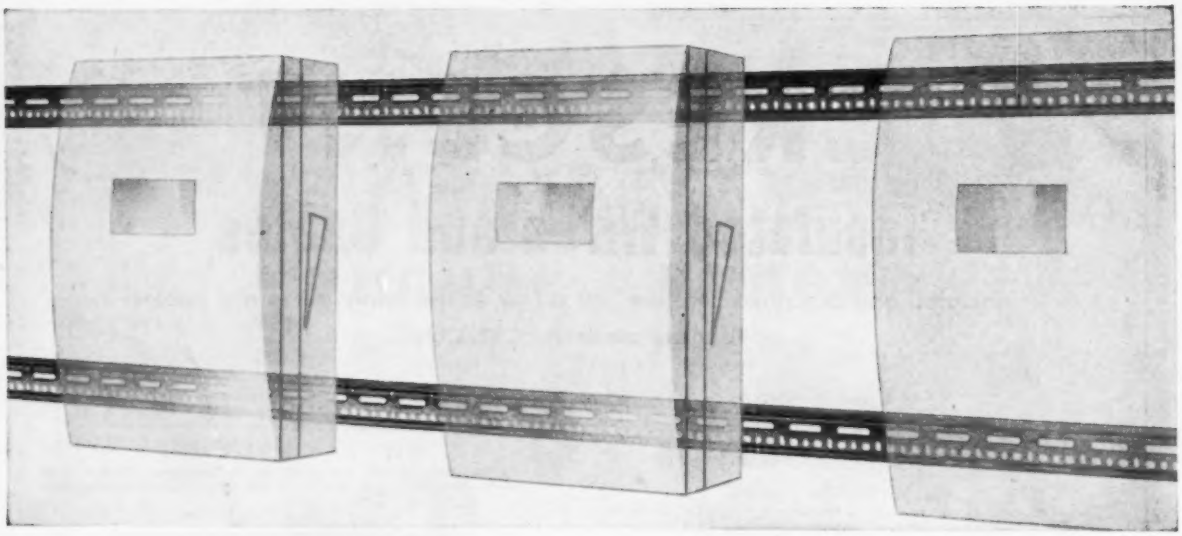


VARNISHED CAMBRIC LEAD ENCASED CABLE

Varnished cambric insulation has high dielectric strength and long life. Not affected by oils and greases. This cable is supplied with lead sheath for wet locations or weatherproof braid for dry locations.

CRESCENT INSULATED WIRE & CABLE CO.

TRENTON 5, N. J.



Reduce Electrical Installation Costs . . . frame with

ACME STEEL DEXION SLOTTED ANGLE

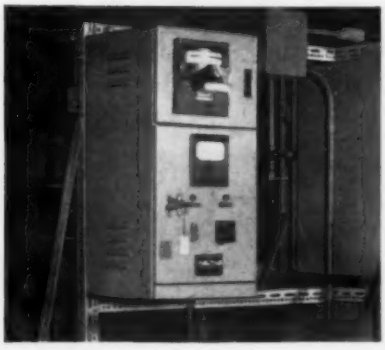
Why Acme Steel Dexion cuts installation costs: Dexion Slotted Angle frames so conveniently because the scientifically engineered slot and hole patterns always match up; electrical components can be mounted so easily on a Dexion frame because a slot or hole is always available. You can install multiple components of relays, instruments or switchgear without wasting time in drilling or welding.

Dexion Slotted Angle projects are started and completed at the job site—it measures, cuts and bolts in fast, simple succession with amazing speed. A single downstroke of the Dexion Cutter shears squarely and cleanly; a single wrench draws up all bolts.

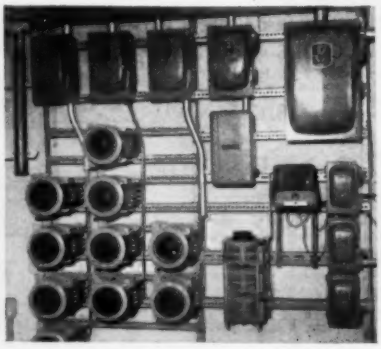
Acme Steel Dexion Slotted Angle is strong—rigidly holds many hundreds of pounds—and is available in either standard or heavy-duty gauge. Edge-smooth, cold rolled Acme Steel Dexion is galvanized for rust and corrosion resistance, is completely re-usable, over and over.

Many contractors regularly depend on Acme Steel Dexion because of its versatility, lightweight strength and compactness. Dexion Slotted Angle comes in 10 or 12-foot lengths, ten pieces to a package which includes 75 nuts and bolts and takes less than the space of two 2 x 4's.

Learn how Dexion Ideas have cut costs for others. Write, today, for framing ideas and the name of your distributor to Dept. EBD-58, Acme Steel Company, Chicago 27, Illinois.



ACME STEEL Dexion Slotted Angle supports electrical control panel for production line.



ACME STEEL Dexion Slotted Angle frames instrument control housing and switch gear.



ACME STEEL Dexion Slotted Angle speeds installation of lighting fixtures.

ACME STEEL DEXION SLOTTED ANGLE



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The unique double barreled UTILI-TAP connector and matchmated tools offer a completely new and easy way to secure conductors at both ends of the service drop, at transformers and loop splices. No loose-piece hardware to fumble with, no periodic tightening or arm-wearying tooling. The UTILI-TAP team means maximum performance and long life, with greatest ease of application.

The UTILI-TAP Connector features:

- exclusive double barreled **locking crimp**—to guard against relaxation under varying load conditions
- **tin-plated** to resist corrosion and assure optimum electrical connection
- **pre-inhibited** with non-flow compound to remove oxide from aluminum conductors

The UTILI-TAP Tool features:

- crimping dies are permanently attached to tool head for quick die change
- open type head for easy access to conductor and quick release after application
- portability—lightweight (less than 8 lbs.)
- for wire size range 8 through 4/0 AWG—solid, stranded and ACSR—in all copper and aluminum wire combinations

For more information on the double barreled UTILI-TAP method, write:



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Permanent locked-in bushing insures smooth burr-free raceway for easy fishing. No extra work.

BRIEGEL RED THROAT

1. Protruding rounded red plastic lip of bushing prevents cutting of insulation—eliminates shorts.
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3. Deep dished eight pronged lock nut is easier to drive on—screws flush to shoulder and digs into metal of box for vibration proof positive ground.
4. Two quick squeezes with The Briegel Indenter and BM All Steel Indenter Fittings are set forever. Metal is pressed into metal for permanent installation and positive ground.



NEW POCKET SIZE INDENTERS

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BRIEGEL METHOD TOOL COMPANY

GALVA, ILLINOIS

All B-M Indenter Fittings are U.L. Approved as concrete-tight and for general use (File Card E10863). Also comply With Federal Specifications W-F-406,

ALL BRIEGEL FITTINGS ARE U. L. APPROVED AS CONCRETE-TIGHT

57TH YEAR MAY • 1958

Electrical Construction and Maintenance

To Specify Quality

Specifications are the special language of construction. They describe the work to be done in terms capable of common understanding and interpretation without ambiguity, in sufficient detail to assure that all parties to the contract or negotiation are thoroughly informed and in confident agreement.

The merit of a specification is in the enumeration of particulars. The end product is physical construction, ultimately made up of particular products installed in a particular way. Generalities may serve only up to a point in job description. For execution is always specific in the most minute detail.

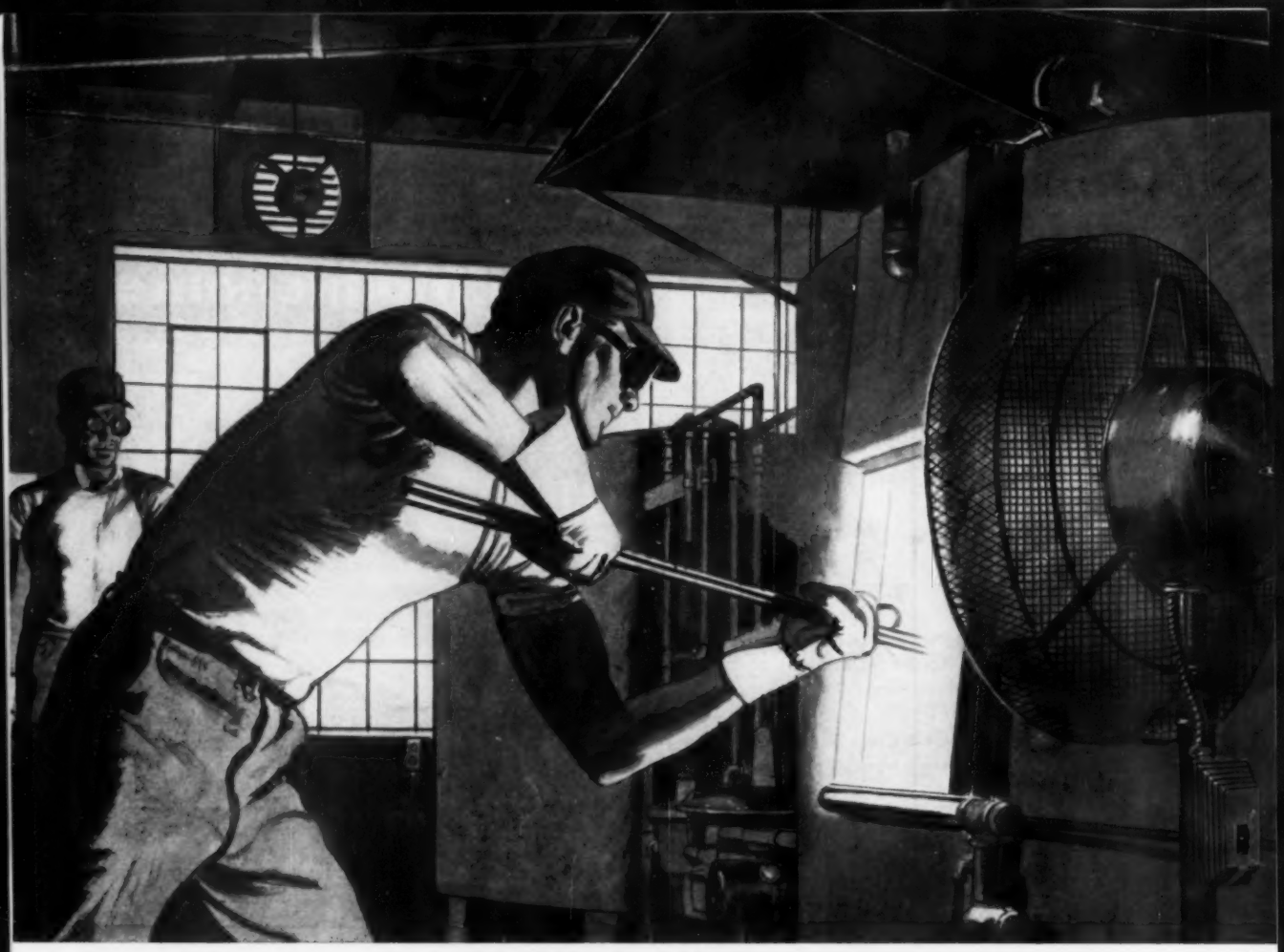
Electrical work is especially in need of good detailed specifications. While industry standards and codes provide working minimums, there are wide ranges in methods and qualities available. The specification must be sufficiently comprehensive to define clearly what is desired and to maintain design quality levels through to completion.

The master electrical specification, to which most of the editorial content of this issue is devoted, is a practical guide for those who prepare specifications for project planning, contract negotiation, work descriptions or communication with suppliers. Typical or prototype paragraphs are written in the imperative mood characteristic of construction specifications so that they may be used directly for, or easily edited and adapted to, most specification needs.

This project is prepared for the use of readers with seasoned experience in electrical construction practice who are expertly familiar with methods and materials appropriate to particular types of electrical installations. It is not intended as a text for untrained persons.

The extent to which the data given is applicable to specific job descriptions and the modifications which may be made to express individual preferences necessarily involve professional knowledge and judgment. And individual preferences for particular products of known value and performance are an essential and vital part of the specification process. They establish quality and insure satisfaction.

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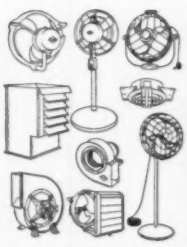
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Electrical Specifications - Index

1.0 GENERAL CONDITIONS 74

1.1 Defining the Project ... 74
1.12 Scope of Work 75
1.2 Bids and Schedules 74
1.3 Governing Conditions .. 74
1.4 Fees and Insurance 75
1.51 Safety Precautions 76
1.63 Materials—Substitutions 76
1.7 Labor and Supervision .. 75
1.8 Approvals 75
1.91 Temporary Power 77

2.0 SERVICE ENTRANCES 78

2.11 Primary Service 79
2.12 Secondary Service 79
2.131 Emergency Standby Equipment 79
2.2 Service Conductors 80
2.31 Overhead Service 80
2.33 Underground Service .. 81
2.4 Service Equipment 81
2.51 Grounding Methods ... 81

3.0 TRANSFORMERS 82

3.1 Application 83
3.2 Characteristics 83
3.3 Construction 84
3.4 Location 84

4.0 CIRCUIT SWITCHING AND PROTECTION 85

4.12 Primary Service Equipment 86
4.13 Secondary Service Equipment 86
4.21 Power and Distribution Panelboards 86
4.22 Lighting Panelboards .. 87
4.23 High Frequency Lighting Panels 87
4.3 Primary Distribution Center 87
4.4 Unit Substations 87
4.5 Switchboards 88
4.6 Control Centers 88
4.7 Safety Switches 89
4.8 Fuses 89

5.0 FEEDERS 89

5.11 Primary Feeders 90
5.12 Secondary Feeders 90
5.2 Underground Systems .. 90
5.22 Direct Burial Cables ... 91
5.3 Conduit Raceways 92
5.4 Cable Boxes 92
5.5 Accessible Wireways ... 93
5.6 Feeder Bus Duct 93
5.7 Armored Cables 94
5.8 Wire and Cables 95
5.86 High Frequency Systems 96

6.0 BRANCH CIRCUIT 97

6.1 Lighting Circuits 98
6.2 Emergency Circuits ... 99
6.3 High Frequency Circuits 99
6.4 Power Circuits 100
6.5 Conductors 100
6.52 Armored Cable 101
6.53 Non-Metallic Sheath Cable 101
6.54 Mineral-Insulated Cable 102
6.55 Open Wiring 102
6.61 Conduit Raceways 102
6.62 Electrical Metallic Tubing 102
6.63 Wireways and Troughs 102
6.64 Surface Raceways 103
6.65 Plug-In Busways 104
6.66 Trolley Type Busways .. 104
6.67 Underfloor Duct 105
6.68 Cellular Steel and Concrete Floors 105
6.7 Hazardous Locations ... 106
6.8 Raceway Accessories ... 106
6.81 Conduit Fittings 106
6.82 Outlet Boxes 107
6.83 Junction or Pull Boxes .. 107
6.91 Receptacles 107
6.92 Switches 107
6.93 Time Switches 108
6.94 Central Control 108
6.95 Low Voltage Control ... 108
6.96 Plates 108

7.0 LIGHTING 109

7.11 Scope of Work 110
7.12 Drawings 110
7.15 Luminaire Wiring 110
7.16 Optional Equipment ... 111
7.2 Installation Details ... 111
7.3 Fixture Schedule 111
7.4 Trans-Lighted Ceilings. 112
7.5 Special Lighting Fixtures 113
7.51 High Frequency Luminaire 113
7.61 Descriptive Fixture Specification 114
7.62 Catalog Designation Fixture Specification ... 114
7.63 Direct Type Luminaires 114
7.631 Fluorescent 114
7.634 Incandescent 115
7.635 Mercury-Vapor 115
7.636 Reflector Lamps 115
7.64 General Diffuse Luminaires 115
7.65 Semi-Indirect Luminaires 116
7.66 Indirect Luminaires ... 116
7.7 Emergency Lighting Units 116
7.8 Hazardous Area Lighting 116
7.91 Floodlighting 116
7.92 Street Lighting 116

8.0 MOTORS, GENERATORS AND CONTROLS 117

8.1 Furnishing Equipment .. 118
8.2 Handling Equipment ... 118
8.3 DC and Induction Motors 118
8.37 Mechanical Protection .. 118
8.39 Motor Data 118
8.41 Synchronous Motor Specification 118
8.54 Motor Generator Sets .. 119
8.542 Rotary Frequency Converter 119
8.61 DC Motor Controls 119
8.62 AC Motor Controls 120
8.63 Control Devices 120
8.7 Installation Details 121
8.75 Controller Specification 121
8.77 Installation Specification 122

9.0 AIR CONDITIONING AND HEATING 122

9.126 Ventilating Fans 123
9.127 Unit Ventilator 124
9.13 Air Conditioning 124
9.134 Air Conditioning Controls 124
9.136 Unit Air Conditioner ... 125
9.2 Electric Heating Equipment Types 125
9.22 Heating Controls 127
9.23 Installation Instructions . 127
9.24 Electric Heating 127

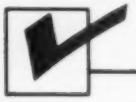
10.0 RESIDENTIAL WIRING SPECIFICATIONS 128

10.1 Service 129
10.2 Panels and Switches ... 129
10.3 Wiring Methods 130
10.31 Outlet Boxes 130
10.4 Branch Circuits 130
10.41 General Circuits 131
10.42 Lighting Circuits 131
10.43 Appliance Circuits 131
10.44 Isolating Circuits 131
10.45 Individual Circuits 131
10.46 Unit Air Conditioners .. 131
10.5 Wiring Devices 131
10.51 Outlet Location 131
10.52 Control Switches 132
10.53 Dimmer Switches 132
10.55 Receptacles 132
10.56 Multi-Outlet Assemblies 132
10.6 Relay Switching 132
10.7 Exhaust Fans 132
10.8 Space Heating 133
10.91 Door Chimes and Signals 133
10.92 Intercom Systems 133
10.93 Fire Alarm Systems 133
10.94 TV Antenna Systems .. 134
10.95 Hi-Fi Sound Systems ... 134

11.0 SIGNAL, COMMUNICATIONS AND AUXILIARY SYSTEMS 134

11.1 Intercommunicating Telephone 134
11.2 Public Telephone 139
11.3 Sound 139
11.4 Paging 252
11.5 Fire Alarm 258
11.6 Electric Clock 273
11.7 Program Signal 276
11.8 Nurses' Calling 281
11.9 Television Antenna 293

1.0 General Conditions



- ☐ **Bids, Contract and Schedules**
- ☐ **Bonds** — performance
- ☐ **Changes** — plans and specifications
- ☐ **Cutting, Patching and Repairs**
- ☐ **Definitions** — contract and specification terms
- ☐ **Description of the project**
- ☐ **Drawings** — working, shop
- ☐ **Electrical Work,** scope of
  - — in this contract
  - — not included in contract
  - — by others
- ☐ **Examination of Site and Other Drawings**
- ☐ **Field Office and Storage Areas**
- ☐ **Guarantee**
- ☐ **Inspections**
- ☐ **Insurance,** indemnity
- ☐ **Interference with Other Trades**
- ☐ **Labor and Supervision**
- ☐ **Licenses, Permits, Fees, Taxes**
- ☐ **Materials** — type and quality
  - — furnished and installed by this contractor
  - — furnished by others but installed by this contractor
  - — furnished and installed by others, but connected by this contractor
- ☐ **Payments** — when, how made and on what basis
- ☐ **Protection** — to life and property, watchman, etc.
- ☐ **Removal of Rubbish,** etc.
- ☐ **Rules and Regulations** — codes, ordinances, etc.
- ☐ **Safety**
- ☐ **Signs** — protective, advertising, etc.
- ☐ **Sleeves, Slots, Chases and Openings**
- ☐ **Specifications** — intent and precedence
- ☐ **Substations** — material and equipment, how handled
- ☐ **Temporary Facilities** — light, heat, power, water
  - — who is to supply and pay for each
- ☐ **Temporary Work**
- ☐ **Termination of Work**
- ☐ **Other Items** dictated by specific project

GENERAL Conditions of a specification are those which refer to the project as a whole and which apply to all contractors and suppliers involved in the work. Certain considerations, such as Scope of the Work, must be tailored to the specific installation described by the rest of the specification.

Depending upon size type and complexity of the project, these conditions may consist of a few paragraphs or may include numbers of pages giving detailed instructions to the bidders and installing contractors.

General Conditions covering a specific project could be amplified in accordance with the following outline:

1.1 Defining the Project

1.11 General description of the property, building layout, construction, height, type of occupancy, boundary lines, address and similar descriptive material.

1.12 Scope of the work; listing all systems that are to be included in the contract and which will be discussed in detail in subsequent sections of the specifications. This section should also spell out what electrical work is *not included* in the contract; what electrical equipment items are to be furnished by others, but installed by this contractor; what electrical equipment is to be furnished and installed by others, but connected by this contractor.

1.13 Drawings related to the specifications; which ones are to be considered "working drawings"; instructions relating to "shop drawings" to be supplied by the contractor and equipment suppliers; addition to plans of changes dictated by local conditions and encountered during installation. Some specifications also direct the contractor to submit a final set of corrected "as installed" drawings upon completion of the work.

1.14 Symbols and abbreviations.

1.15 Definition of terms.

1.16 Addenda, revisions, alternates.

1.17 Examination of the site to eliminate misconceptions of fact and to verify dimensions, available utility services, topographical features, transportation provisions, storage facilities.

1.18 Surveys for datum planes, elevations, benchmarks and stakes; how to request and by whom to be made.

1.19 Order of precedence—specifications, plans, drawings, etc.

1.20 Examination of drawings of other trades and systems for checking.

1.2 Bids and Schedules

1.21 Method of submitting bids; to whom, when, in what form, and with what alternates.

1.22 Time schedules, work program, layout of work.

1.23 Inspection, supervision, approvals.

1.3 Governing Conditions

1.31 Codes, regulations, safety orders, building laws and ordinances, such as the National Electrical Code, American Institute of Architects' contract for construction of buildings, State Industrial Accident Commission orders, plus any other national, state, municipal, utility or company directives relating to the contemplated type of work.

1.32 Code rulings and interpretations; by whom rendered in event of question.

1.33 Precedence of design features outlined in specifications and drawings, if they are over and above requirements of relevant Codes.

1.34 Arbitration of errors or conflicts—how handled.

1.35 Responsibility, status and definition of owner, architect, engineer and contractor.

1.4 Financial Considerations

1.41 Insurance coverage for fire, theft, public liability, workman's compensation.

1.42 Bond for evidence of financial responsibility.

1.43 Local fees related to securing all required permits, certificates.

1.44 Method of payment, governed by either prefixed dates, progress reports, progress photographs, payroll, bills of materials; retained percentages; final payment.

1.45 Withholding Social Security deductions from payroll of workers.

1.46 Liens.

1.47 Responsibility for taxes.

1.5 Protection

1.51 Physical precautions related to protection of materials, tools, equipment, working personnel, public.

1.52 Enclosed storage areas, tool cribs, work sheds, field offices, general headquarters.

1.53 Provision for watchman service, fire extinguishers.

1.54 Guard rails around excavations or elevated work areas, padlocks on enclosures, notices and warnings pertaining to high voltage, protective guards on power saws, drills and similar tools.

1.55 Approved tools, appliances, devices, scaffolds and hoisting equipment for use during construction.

1.6 Materials

1.61 Required standards, labels, approvals, tests, samples.

1.62 Specification by manufacturer, brand name and catalog number—intent; meaning of "or approved equal" clauses.

1.63 Substitution of material or equipment items for those specified—on what basis and when permitted; procedure to follow.

1.64 Quality of related hardware on the job.

1.65 Causes for rejection of materials or equipment.

1.66 Gauges of metal used in enclosures and boxes; wire and cable sizes.

1.67 Point of delivery on job site of material and equipment; on what dates.

1.68 Movement of material and equipment from job site delivery point to installation point—by whom; how protected against theft, damage or deterioration.

1.7 Labor

1.71 Governing labor laws, prevailing or acceptable wage scales to be followed.

1.72 Specifications of labor force, such as skill of mechanics, supervision ratio of foremen to journeymen to apprentices, etc.

1.73 Clauses relating to anti-discrimination, preference to handicapped workers or veterans, seniority and similar factors where applicable.

1.74 Reasons for dismissal.

1.8 Approvals

1.81 Claims for extensions of deadlines, overtime pay.

1.82 Permissible causes for suspending work.

1.83 Field revision of plans, substitution of materials, departure from recommended installation methods, conflicts between plans and specifications, conflicts with other trades.

1.9 Temporary and Related Conditions

1.91 Electric service for lighting, power and heat during construction or installation periods.

1.92 Advertisements, signs, notices.

1.93 Use of installation photographs for commercial purposes.

1.94 Cutting and patching.

1.95 Excavation and backfill.

1.96 Installation of sleeves, chases and openings.

1.97 Repair and maintenance.

1.98 Removal of debris from premises during and after completion of work.

To protect all parties involved in a contract, the specification should eliminate all possibility of misunderstanding or confusion. Therefore, any conditions contained in the document should be presented in detailed form.

For example, typical clauses from the General Conditions of a specification might appear as follows:

1.12 Scope

The work covered by this specification shall include furnishing all labor, material, equipment and services to construct and install the complete electrical system as shown on the accompanying plans and specified herein. This work shall include the following:

- **A. Outdoor high voltage switching station.**
- **B. Underground feeders from switching station to unit substations in plant.**
- **C. Unit substations including primary disconnect facilities, transformer, and secondary switchgear.**
- **D. Complete distribution system for lighting including necessary transformers, feeders, distribution panelboards, branch circuits, lighting fixtures, control switches and receptacles.**
- **E. Complete distribution system for power including bus duct feeders, branch circuit plug-in type disconnects, and cable drop connections to motors.**
- **F. Underfloor duct distribution system, first floor, office area.**
- **G. Cellular floor distribution system, second and third floor, office building.**
- **H. Empty raceways and cabinets for Bell Telephone system.**
- **I. Receiving, handling, setting and connecting motors and controls.**
- **J. Clock system, including provision of clocks and regulators.**
- **K. Paging, including fire alarm and security systems, provision of equipment.**
- **L. Lighting system; parking lots.**
- **M. Grounding.**

1.121 Work Not Included

The following items are not included in these electrical specifications:

- **A. Provision of certain motors and controllers—by owner.**
- **B. Telephone system wire, cable, equipment and instruments—by Telephone Company.**
- **C. Elevator signal and control wiring beyond service feeder noted on plans—by others.**
- **D. Provision of motor controls covered in applicable sections of the mechanical specifications for this project.**

1.13 Drawings

The (architect's, engineer's) drawings, which constitute an integral part of this contract, shall serve as the working drawings. They indicate the general layout of the complete electrical system: arrangement of feeders, circuits, outlets, switches, controls, panelboards, unit substations, service equipment, fixtures, and other work.

Field verification of scale dimensions on plans is directed since actual locations, distances and levels will be governed by actual field conditions.

The electrical contractor shall also review architectural, structural, plumbing, heating and ventilating plans and shall adjust his work to conform to all conditions indicated thereon.

Discrepancies shown on different plans, or between plans and actual field conditions, or between plans and specifications shall promptly be brought to the attention of the (inspector, engineer, architect, etc.) for a decision.

The following drawings are part of this specification and contract:

Drawing No.	Date	Title
E-1	May 1, 1957	High Voltage Switching Station
E-2	May 1, 1957	Underground Distribution System
E-3	June 5, 1957	Power System—Manufacturing Area
E-4	June 15, 1957	Lighting System—Manufacturing Area
E-5	July 1, 1957	Electrical System—Office, 1st Floor
E-6	July 10, 1957	Electrical System—Office, 2nd Floor
E-7	July 10, 1957	Electrical System—Office, 3rd Floor
E-8	July 10, 1957	Lighting—Parking Lots

These drawings may be superseded by later revised or detailed drawings or specification addenda prepared by the (architect, engineer) and the contractor shall conform to all reasonable changes without extra cost to the owner. All items not specifically mentioned in the specifications or noted on the drawings but which are obviously necessary to make a complete working installation shall be included.

1.131 Shop Drawings

If shop drawings are to be required of the contractor, a statement to this effect should be included in the specifications. This may be handled as follows:

The contractor shall submit to the (architect, engineer) detailed dimensioned shop drawings covering all items of equipment and brochures of all lighting fixtures. No equipment should be put into manufacture (or ordered) until these shop drawings or brochures have been approved by the (architect, engineer).

The following procedure shall be followed: The contractor shall submit ———— prints of shop drawings to the (architect, engineer) for comment or correction. The contractor shall then submit ———— sets of prints of corrected shop drawings to the (architect, engineer) for final approval. The same procedure shall apply in making shop drawing revisions.

Frequently, contractors are requested to prepare and submit to the architect or engineer a set of dimensioned "working drawings" showing location of equipment, conduit runs, outlets, pull boxes, junction boxes—particularly if field conditions dictate a variation from original plans. When this is intended, such a statement should be included in the specifications.

1.21 Submission of Bids and Award of Contract

Bid proposals shall be made on forms provided by ————. Proposed prices shall be indicated both in figures and in writing. Proposals shall be signed by the bidder or his duly authorized representative, with his address, firm name, title, etc. Bidder's bond shall be executed on the form attached to the proposal form.

All bids shall be presented under sealed cover plainly identified as a proposal for the work bid upon and shall have enclosed therewith a cashier's or certified check for an amount equal to ———— percent of the proposed bid and made payable to ————. The right is reserved to reject any or all proposals or to award the contract to the responsible bidder with the lowest proposal complying with all prescribed requirements.

The contract award, if approved, will be made within ———— days after opening of sealed bids. Within ———— days after bid opening, the owner or his representative will return the proposal guarantees accompanying proposals not to be considered in the award of the contract.

The successful bidder shall sign the contract in duplicate counterpart and return it, with the contract bond, within ———— days after receipt of contract award notice. The contractor shall also sign a set of plans and specifications for filing with the contract.

1.44 Method of Payment

The contractor shall be paid monthly, as the work progresses, an amount equal to the cost of the work installed that month less ———— percent of the indicated cost as a retained percentage. Monthly payments shall be based upon the contractor's written statement of equipment and materials installed and labor expended for that month. Verification by the engineer will be required before certificates of payment are issued. No payments will be authorized until any defective work and materials have been removed, replaced and made good.

Within ———— days after completion of the work by the contractor and its acceptance, in writing, by the (engineer, architect, owner), the unpaid balance of the contract price will be paid under a certificate issued by the (engineer, architect, owner).

1.51 Safety Precautions

The contractor shall furnish and place proper guards for prevention of accidents. He shall provide and maintain any other necessary construction required to secure safety of life or property, including the maintenance of sufficient lights during all night hours to secure such protection.

1.62 Specification by Brand Name

Where materials, equipment, apparatus, or other products are specified by manufacturer, brand name, type or catalogue number, such designation is to establish standards of desired quality and style and shall be the basis of the bid. Materials so specified shall be furnished under the contract, unless changed by mutual agreement. Where two or more designations are listed, choice shall be optional with the contractor.

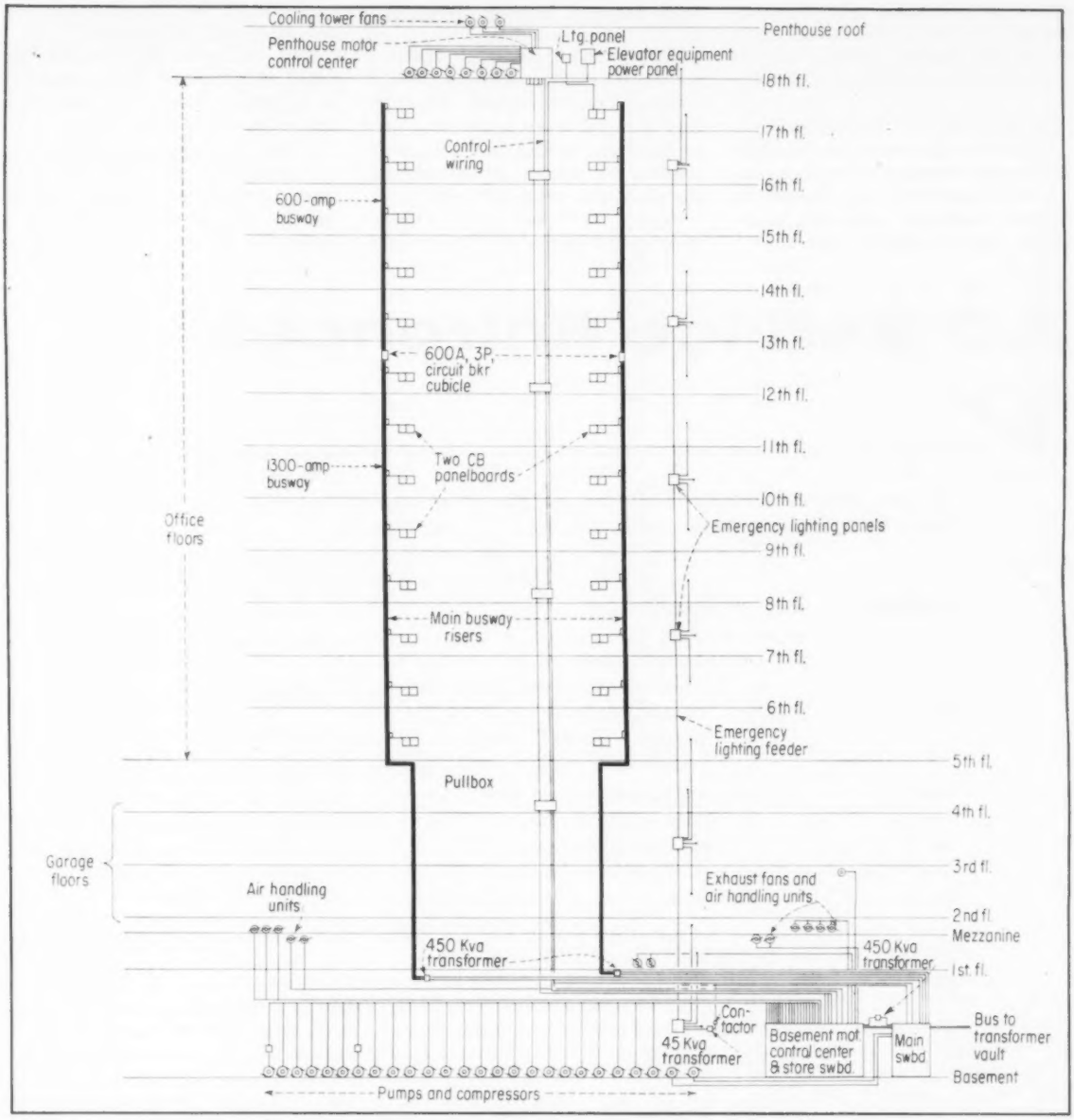
1.63 Material Substitution

It is the intent of these specifications to establish a standard of quality of materials and equipment installed. If the contractor desires, he may submit a request to use any materials or products other than those specified. He shall so state in his proposal and provide a list of the proposed substitutions (manufacturer, brand name, catalogue number, etc.) and state what difference each will make (addition, deduction, no change) in the contract price. He shall also submit data showing the proposed substitutions are equal to the specified types.

Where such substitutions alter the design or space requirements indicated on the plans, the contractor shall include all items of cost for the revised design and construction including cost of all allied trades involved.

Acceptance or rejections of the proposed substitutions shall be subject to approval of the (architect, engineer, owner). If requested by the (architect, engineer, owner), the electrical contractor shall submit for inspection samples of both the specified and proposed substitute items.

The trend in modern specification writing is to use brand names or catalogue numbers instead of detailed descriptive clauses to establish material and equipment quality. This adds clarity and conciseness to a given specification, makes it easier for a bidder to estimate cost, simplifies



A GOOD RISER diagram presents an overall electrical distribution system picture for a multi-story structure; helps interpret the design engineer's concept; facilitates take-off, estimating and installation.

ordering specified items after the contract has been awarded. To attain this goal, the design engineer, specification writer and contractor must be familiar with current advances and developments in electrical materials and equipment; also latest manufacturers' catalogue designations.

1.72 Supervision

The electrical contractor shall personally, or through an authorized and competent representative, constantly supervise the work from beginning to completion and final acceptance. So far as possible, he shall keep the same foremen and workmen throughout the project duration.

During its progress the work shall be subject to inspection by representatives of ———— at which times the contractor shall furnish required information.

1.82 Suspending Work

The contractor may request in writing suspension of work when circumstances or conditions make it impractical or unreasonable to proceed with a substantial portion of the work. Occurrence of a national emergency resulting in a federal order diverting critical materials, equipment or labor; or freezing or untenable weather conditions comprise circumstances that would bear such consideration.

1.91 Temporary Power

The electrical contractor shall furnish, install, maintain, and remove after construction is completed, a ———— ampere, ———— volt, ———— phase, ———— wire temporary power and lighting system as shown on drawing ————.

The system shall consist of a service, distribution system, panelboards, grounding, branch circuits, and receptacle outlets as shown on the drawing.

Each trade shall provide and pay for its own extensions for lights or power tools beyond the receptacle outlets on the columns; and beyond the 3-phase panelboard sub-mains in the case of 3-phase power tools.

1.96 Sleeves, Inserts, Openings

The electrical contractor shall lay out and install his work in advance of pouring concrete floors or walls. He shall furnish and install all sleeves or openings through floors or walls required for passage of all conduits, pipes or ducts installed by him.

Sleeves shall be of ———— gauge galvanized sheet steel rigidly supported and suitably packed to prevent ingress of wet concrete.

This contractor shall furnish and install all inserts and hangers required to support bus bars, bus duct, conduit, cables, pull boxes, etc.

If the sleeves, hangers, inserts, etc., are improperly installed, this contractor shall do all necessary cutting and patching, at his own expense, to rectify the errors.

2.0 Service Entrances



- ☐ **Bus Assembly or Bus Duct** — size, voltage, phase and number of conductors
- ☐ **Characteristics of Service** — volts, amperes, phase, No. of wires
  - — primary — over 600 volts (2.4 kv; 4.16 kv; 6.9 kv; 13.8 kv etc.)
  - — secondary — 600 volts and under (120/240; 208/120; etc.)
- ☐ **Conductors** — type (insulation) and size
  - — single conductor
  - — multi-conductor assembly
- ☐ **Connections** — types of cable connectors to be used, splicing instructions, etc.
- ☐ **Disconnecting Means** — service equipment
  - — primary — circuit breakers, interrupter switches
  - — secondary — circuit breakers, switches and fuses
- ☐ **Ducts** — conduit (metal, fiber, asbestos-cement, plastic, tile, etc.)
- ☐ **Emergency Service Facilities** — standby generator, battery sets, etc.
- ☐ **Equipment** — details of service equipment (may be covered in Section 4.0)
- ☐ **Grounding** — methods and details of grounding service and equipment
- ☐ **Location of Service Equipment** — exact location on property or building
  - — point of attachment to utility lines
- ☐ **Multiple Service Requirements** — different voltages
- ☐ **Routing of Service Entrance** — overhead — pole line and service drop
  - — underground — trenching details and protection
- ☐ **Structures** — details of switching and/or transformer structures
  - — outdoor structures
  - — indoor vaults
  - — manholes for underground service
- ☐ **Other Items** dictated by specific project

An electrical service includes all the conductors and the equipment necessary to deliver energy from a main utility supply system to the wiring system of the individual premises being served. Service techniques vary with the size of the installation, voltages used, and design requirements (overhead or underground). They can range from a simple secondary service from a utility pole line or transformer installation (to a main distribution center within a building) to a more complex system involving primary lines, switching centers, and primary underground feeders to numerous distribution centers (unit substations) throughout a building.

The service entrance specifications should cover in detail all mediums (overhead or underground circuits) required to transmit power from the utility lines to the "service" equipment within the building. This means definitive clauses relating to cables, raceways, plus all equipment and accessories for power cutoff or interruption, circuit protection, primary (or secondary) metering and grounding.

Size of installation, voltage levels and distances involved normally have a bearing on the type of service design. Incoming service systems may incorporate enclosed busways, specially designed bus bar structures, interlocked armor cable, multiple conductors per phase enclosed in paralleled conduits or ducts, direct burial cables or conductors, multi-conductor cables, aerial cables, or special insulations for open wiring. In all cases, the specifications should be explicit concerning type, size and number of cables, phase and voltage characteristics, method of supporting the distribution medium, de-

tails of installation and of protection.

Where multiple services are indicated (power, lighting, emergency, etc.) details of such service sources should be clearly stated in the specifications. Means of providing emergency power (batteries, generators, etc.) and means of transferring from one source to the other (automatic transfer switches) should be detailed in the specification clauses.

Where primary distribution from a switching center to a large number of unit substations is extensive, specification clauses regarding such feeders may be included under Section 5.0 (Feeders).

The Service Entrance section of a typical electrical specification could include any or all of the following examples of typical clauses indicated in boldface type.

2.1 Characteristics

Define the service characteristics—voltage, frequency, phase, and number of wires. This information should also be noted on the relevant plans accompanying the specifications.

2.11 Primary service entrance

Specifically state what primary service work is to be done by the electrical contractor, giving necesary details on equipment locations and service facilities. Generally this phase of the work is done by the serving utility, but there are cases where part of it is done by the electrical contractor. For example:

The electrical contractor shall furnish and install two primary———kv underground —— in. fibre duct systems encased in a —— in. concrete envelope, as shown on Drawing No. ——. One duct line shall originate at the (utility) Company ——— kv lines on ——— Street; the other at similar lines on —— Street. Both ducts shall terminate at the (utility) Company outdoor substation behind the plant boiler house. The (utility) Company will furnish and install all —— kv cables in these ducts and do all wiring for their transformers and switchgear concerned with the —— kv system.

The electrical contractor shall (furnish and) install a ——kv outdoor, metal clad switching center consisting of ——— (interrupter switches and fuses) (circuit breakers) of capacities as noted on Drawing No. ——. This contractor shall furnish and install the No. ——, —— insulated, ——kv cables, ground cable and conduit systems between the incoming ——kv sections of the metal clad switchgear and the secondary busses of the (utility) Company outdoor substation, and make all connections to these busses.

This contractor shall furnish and install the necessary conduits and wiring between the metal clad switchgear and the meter house as required by the (utility) Company, also the ground rods and underground cable system for equipment ground of the outdoor metal clad switchgear and grounding of metal fence around switchgear.

In an installation of this type, primary service entrance can be considered to terminate at the outdoor switchgear. From there on out, it is a primary distribution system to the various unit substations within the plant or building. Specification clauses concerning such feeders can be added here, or included in the section on Feeders (5.0).

2.12 Secondary service

Power for distribution within the building will be available from the secondary side of transformers supplied by the (utility) Company. This service shall be ——amp, ——phase, ——wire, ——/——volts, 60-cycle, alternating current for normal power and lighting requirements. General arrangement of the transformer vault, switchgear room and connecting main is shown in Drawing No.——. Conductor sizes and enclosures shall be as noted on this drawing.

The electrical contractor shall (furnish and) install all equipment items and connections to the secondary side of the transformers and make all wiring connections to the current transformers and tie busses as shown. This contractor shall furnish and install the tie busses, limiting lugs, terminals, etc., to make a complete connection in each case. Bus tie shall be (size), (type) conductor as noted on plans. Terminals for secondary connections at the transformers shall be supported independently from the transformers so that any transformer may be easily removed.

2.13 Auxiliary services

Specify any auxiliary services required by the system design—such as batteries, motor-generator emergency sets, other voltages or frequencies, direct current, and similar "special use" systems. Typical specification clauses for emergency service sets follow.

2.131 Standby Generator

Furnish and install where indicated on Drawing No. ——, an emergency standby generator rated at ——kw, —— volts, —— phase, 60-cycle. It shall consist of a —— engine direct connected to a single-bearing, 4-pole generator with associated equipment to automatically start the engine upon failure of normal power source and to automatically transfer the emergency load from the normal power source to the standby generator.

Generator shall be of saturated field, 4-pole, revolving armature design connected direct to engine flywheel by a semi-flexible steel driving flange to insure permanent alignment. Generator shall be rated ——kw continuous output, —— volts, —— phase, —— cycle with an inherent 10% voltage regulation from no-load to full-load. Engine shall be cranked through the generator exciter through a special 12-volt cranking winding with current obtained from a 12-volt battery. Batteries shall be recharged from the exciter with charge rate controlled by an automatic regulator.

Engine shall be a —— cycle, —— cooled type with ——cylinders and a displacement of —— cubic inches. Rating shall be —— hp maximum at ——rpm operating speed. Engine shall have automatic choke, 12-volt battery ignition and gear-driven distributor.

The wall-mounted control panel shall contain a magnetically-held transfer switch, automatic engine-starting relays and a cranking limiter to open the starting circuit after about 45 seconds if engine fails to start. A four-position control switch shall permit selection of "stop", "manual start", "test", and "automatic" positions. Control panel shall contain a 12-volt battery trickle charger to maintain full charge on starting batteries.

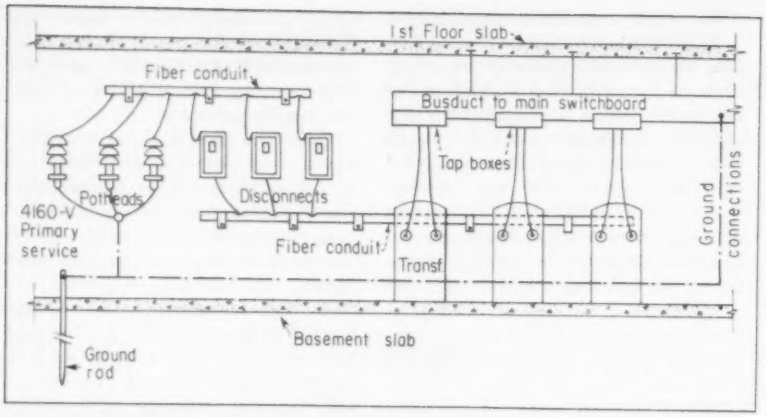
Generator unit instrument panel shall contain a water temperature and oil pressure gauge, battery charge rate ammeter, 12-volt panel light, stop, start buttons, manual reset circuit breaker, necessary voltmeters and ammeters and a duplex plug receptacle outlet.

The complete emergency standby generator unit shall be as manufactured by the ——— Company, or approved equal.

2.132 Storage battery set

Furnish and install, where indicated on Drawing No. ——, a storage battery emergency standby set capable of providing total emergency electrical load for a period of two hours, complete with control panel to operate at building current and a suitable means of maintaining batteries in fully charged condition.

The storage battery shall consist of —— cells capable of delivering —— amps for a period of two hours, when fully charged, to a final voltage of not



SECTION THROUGH BASEMENT VAULT of a high school building shows relative locations of incoming primary service facilities, transformers, and secondary 2,000-amp, 3-phase, 4-wire low-impedance bus duct to main switchboard.

less than 105 volts across the battery terminals.

The automatic control cabinet shall contain a double-pole automatic switch to transfer emergency circuit from normal supply source to battery unit upon failure of normal supply and vice versa when normal service is again restored. This transfer switch shall be mounted in an accessible place and rated —— amps, —— volts, to carry the total connected emergency load. The face of the control cabinet shall contain a voltmeter, a battery ammeter and a switch for control of the emergency circuit.

Circuit protection shall be provided for protection of the normal supply circuit, and the charging device, of the same type as specified for panelboards.

A rectifier, capable of charging the —— cell battery, shall be accessibly mounted in the cabinet. Rectifier shall be designed for use on available building current and shall have an approximate average charging rate of —— amps. When connected through proper resistance in the cabinet, the charger shall be capable of trickle charging the battery at the proper rate.

All equipment shall be left in operating condition and copies of detailed instructions covering maintenance, care and operation of the equipment shall be furnished.

The storage battery emergency standby unit shall be as manufactured by the —— Company, or approved equal.

2.14 Multiple entrances

When the system design calls for more than one service entrance, specify and list each separately. This may cover separate services for fire pumps, emergency lighting, different voltages, varied occupancies and similar items.

2.2 Conductors

List the number, sizes, type of insulation, voltage rating and, where considered necessary, construction characteristics of all conductors specified. Such information facilitates cost estimating and purchasing of conductor items.

2.21 Cables

Where cables are to be of a special type (other than the common building types listed in the NEC) or for use on high voltage systems, definitive clauses describing such cables should be included in the specifications. The following is a typical specification clause for a high voltage cable:

All cable for the 13.2 kv system shall be 300 MCM, 15 kv, single conductor, shielded for a grounded system, with coated copper conductors, Butyl base insulation and Neoprene base jacket. Cable shall be (manufacturer), (trade name), Specification No. ———, or approved equal. All such cable shall be in accordance with, and conform to the latest requirements of the Insulated Power Cable Engineers Association.

The electrical contractor shall fireproof all high voltage cables exposed in manholes and cable closets. Fireproofing shall consist of an inner wrap of (manufacturer) (trade name) asbestos tape applied wet and covered with a layer of (manufacturer) No. ——— cable wrapping tape, 2 in. wide and 1/16 in. thick, applied with a half lap and with the ends tied with lead or zinc wire. All ducts from manhole to building shall be sealed at the manhole end with (manufacturer) (trade name) seal compound.

2.22 Connections

Be specific about method of making cable connections at terminal points.

All 15 kv cables shall terminate in a solder type water-tight lug. Cable ends shall be filled with solder to prevent moisture from entering between the cable wire strands. After stress cone has been made, cable and lug shall be protected with a moisture seal of No. ———, (trade name) plastic tape wrap.

2.23 Splices

Tell precisely where and how cable splices should be made.

All high voltage splices shall be made with a splice approved for the specific type of cable installed and in accordance with recommendations of the cable manufacturer. The electrical contractor shall employ an experienced cable splicer to make all terminations and splices in the high voltage cables.

2.24 Identification

Specifications should be definite about the extent of color coding of conductors throughout the system; also tagging at terminals for identification purposes. If conduits, raceways or enclosures are to be painted distinctive colors for identifying systems, or voltages, this item should be included in the specifications. If the electrical contractor is to be responsible for such painting, the specification should clearly state this.

2.25 Testing

Clearly state what electrical system tests are to be made by the electrical contractor, when they are to be made and in whose presence (architect's, owner's, engineer's representative) they should be conducted. If new testing equipment is to be furnished by the electrical contractor for later transfer to owner, clearly state this in the specification giving necessary data as to equipment type.

2.3 Routing

Supplement layout on plans with definitive specification clauses relating to service conductor point of origin, termination, equipment location, whether service is overhead or underground, methods of installing and terminating service conductors.

2.31 Overhead service

From pole line, pole transformer, elevated transformer structure, aerial cable, etc. Note number, type, spacing, and method of installing poles and conductor supports if additional poles are required on the customer's premises.

2.32 Service drop

State clearance from roof, ground, walls, windows, doorways, shafts, etc., and point of attachment to building.

2.33 Service connections

Specify means of attachment of service conductors and mechanical protection necessary. This clause covers such items as potheads, service entrance heads, sealed raceways, entrance through building and connection in indoor equipment. For example:

High voltage cable shall terminate at potheads having the rated voltage and conductor capacity to accommodate the cable used. Potheads shall be ———— Company, No. ———, or approved equal, with mounting as required by the conduit system installed. Potheads shall be filled with compound suitable for high voltage service. Heating and pouring instructions of the pothead and compound manufacturers shall be followed.

2.33 Underground

From street main, duct line, ground vault, street pole line, etc. Indicate size, voltage and insulation of conductors. Note whether service conductors are to be buried directly in a trench (add any required mechanical protection between conductors and backfill). If enclosed in a raceway, state size, type (metal, fiber, plastic), and mechanical protection (concrete envelope, etc.) required. Note point of connection at utility pole and type of mechanical protection necessary. Detail specification clauses can be included under section on Ducts (2.34).

2.34 Ducts

This section can include location and specification of other materials related to the service or: type of conduit, bus duct, concrete envelopes (thickness, mix ratio, reinforcing rodding), open wiring, type of pipe bends and elbows, transposition means (conduit-duct, cable-bus, etc.) and means of termination at manholes and other structures.

Furnish and install four 4-in. ducts in two tiers from the utility vaults to the customer vault as shown on Drawing No. ———. Ducts shall be fibre conduit, ———— type, as manufactured by the ———— Company, or approved equal. All sleeve joints shall be waterproofed as per manufacturer's recommendations. Ducts shall be enclosed in a concrete envelope extending at least 3 ins. beyond duct exteriors; concrete to have a mix ratio of ———— cement, ———— sand, ———— coarse hard gravel, and water. Ducts shall be installed not less than — inches below finished grade and shall be graded away from the interior vault.

2.35 Structures

Supplement detailed drawings in the plan set with specification clauses covering pertinent construction features of manholes, vaults, etc.; plus definitive sections on provision of facilities for pulling and racking cables, drainage, access facilities, and relevant items.

2.4 Equipment

List the service entrance equipment items to be installed by the electrical contractor. State clearly which items are to be furnished by others and which by the contractor. Where equipment is a standard catalogue item, give manufacturer's name and catalogue designation to simplify specification clause and establish material quality. Where equipment is to be custom-built, give necessary assembly and construction details including pertinent information as noted in sub-sections 2.41 to 2.43.

Service equipment description may be expanded or completely covered under Section 4.0—Circuit Switching and Protection.

2.41 Disconnecting means

State whether disconnection means (main and branch) are to be: circuit breakers (air or oil, manually or electrically operated, automatically tripped); interrupter switches and fuses (high voltage); or switches and fuses. Note ratings, characteristics, terminal connection methods and construction details (where necessary).

2.42 Circuit protection

List the overcurrent and interrupting capacity rating for each disconnecting means.

2.43 Transfer switches

Where an emergency service is included in the electrical system design, specify the type, rating, and operating features of the automatic service transfer equipment. Where dual incoming lines serve the system, this item is normally an intergral part of the service equipment assembly.

Where emergency service is provided by a standby unit (generator or batteries), this transfer switch item is normally included in the control equipment specifications for the unit (Sections 2.131 and 2.132). State if switch is part of unit or separate.

2.5 Grounding

2.51 Grounding methods

All electrical systems must be grounded in accordance with provisions of the National Electrical Code. Depending upon the size, characteristics of the system and local area conditions, any or all of the following methods may be specified: Ground to cold water piping system, metal building framework with deep footings in moist earth, driven rod assemblies, buried plates, metal mesh or conductor grid arrangements.

Descriptive specification clauses should supplement detailed drawings of the grounding system. The following are typical specifications:

Grounding shall be accomplished by means of "grounding assemblies" as indicated on Drawing No. ———.

Single Rod **assemblies shall consist of one ——— ground rod, —— in. diameter, and —— ft long with a clamp at the top and a No. —— bare stranded copper conductor to equipment to be grounded. Ground conductor shall be buried —— ins. in the ground.**

Three-Rod **assemblies shall comprise three ——— ground rods each —— in. diameter, and —— ft long spaced —— ft apart in the form of an equilateral triangle; a ——— clamp at top of one rod to accommodate a No. —— bare stranded ground cable to equipment to be grounded; and a No. —— bare stranded copper cable circling the three rods —— ins. below grade and brazed to each rod.**

Water Pipe connection. **Furnish and install a No. —— Type ——— conductor in a —— in. rigid (galvanized) conduit from the neutral bus in the lighting switchboard to a 1-in. or larger cold water pipe in the boiler room. Water pipe connection shall be with a ——— ground fitting that bonds both conduit and conductor to water pipe. Furnish and install a No. ——, Type ———— bonding jumper with approved ground clamps around the water meter.**

Grounding Bus **in the switchboard room shall be (size) copper bus bar, as shown on plans, mounted —— ins. above finished floor. Bus shall be drilled and tapped to receive a No. — grounding cable connection from the three-rod ground assembly and ground connections for equipment in the switchboard room.**

Furnish and install a (size) copper bus bar from the main ground bus to each equipment item. Bus shall be recessed flush in the finished floor. Necessary grounding and patching

around bars to be done by the electrical contractor.

2.52 Bonding methods

Specify bonding methods to insure ground continuity at expansion pull boxes or conduit sleeves, cable sheaths in manholes, etc.

2.53 Installation

The tops of all ground rods shall extend —— ins. above finished grade.

Ground plates, metal mesh arrangements, ground cable grids and cables connecting ground rod assemblies and grounded equipment shall be installed —— ins. below finished grade.

Grounding conductors shall be so installed as to permit shortest and most direct path from equipment to ground.

Unless otherwise specified, all ground conductors shall be installed in exposed metal conduit with both conductor and conduit bonded at each end.

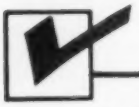
All connections to ground conductors shall be accessible for inspection and made with approved solderless connectors brazed (or bolted) to the equipment or structure to be grounded. All contact surfaces shall be thoroughly cleaned before connections are made to insure good metal to metal contact. Follow engineer's recommendations.

All ground bus bar shall be continuous throughout its length without joints or splices. All taps from the main ground bus bar shall be of approved solderless connection with all contact surfaces clean. Cap screws, bolts, nuts, and washers shall be silicon bronze.

2.54 Tests

The resistance between ground and absolute earth shall not exceed —— ohm and shall be measured by the electrical contractor in the presence of (authorized personnel) before equipment is placed in operation.

3.0 Transformers



- ☐ **Application** — main transformer
  - — master station
  - — load center substation
  - — local transformation
  - — special purpose
- ☐ **Characteristics** — primary voltage and connections
  - — secondary voltage and connections
  - — frequency
  - — kva rating
  - — impedance
  - — percentage taps, number
  - — polarity
  - — noise level, decibel rating
  - — type of coils and enclosure
- ☐ **Type of Transformer** — liquid cooled
  - a. oil
  - b. non-inflammable liquid
  - — air cooled dry type
  - — sealed dry type, inert gas filled
- ☐ **Related Equipment**
  - — bus structure
  - — primary switching
  - — secondary switching
  - — instrumentation
  - — temperature alarm system
  - — ventilation
    - — natural circulation
    - — fan forced circulation
- ☐ **Location and Installation** — outdoor fence-enclosed concrete mat
  - — separate building or vault enclosure
  - — indoor vault or special room
  - — roof, open or structural enclosure
  - — indoor balcony, open or enclosed
  - — main floor
  - — roof truss or building columns
- ☐ **Related Drawings** — one line diagram
  - — vault construction, noise attenuation, ventilation
  - — mounting and support details
  - — plan and elevation for equipment alignment
- ☐ **Other items** dictated by specific project

Modern electrical distribution systems are using increasingly larger numbers of transformers. The economics of modern system design within a plant or building, in many cases, is dictating the application of higher distribution voltages (from 2.4 to 13.8 kv) to carry large blocks of power with smaller copper to highly concentrated load areas. This is particularly true of sprawling modern one-story industrial plants and multi-story, high-rise commercial and residential (apartment building) structures.

Transformation from primary distribution to secondary utilization voltages (120/208, 480, 480/277, etc.) at these load concentration points is necessary. The resultant decrease in length of secondary feeders and circuits reduces power losses to a minimum and increases overall electrical system efficiency.

Two developments have considerably expanded the practical application range of transformers to interior wiring systems:

a. The metal clad unit substation or power center; an integrated combination of transformers and switchgear fully self-contained and protected and designed for free standing installation without vault protection in industrial plants and large buildings.

b. The variety of dry type transformers, ranging in capacity from about 1½ kva to approximately 5,000 kva, which require no special enclosures and may be installed in practically any indoor location. Many of the larger units are found in unit substation combinations.

When designating dry type transformer locations, thought should be given to: accessibility; inspection ease; surrounding structural conditions; prevailing atmospheric conditions (humidity, moisture, corrosive elements, dust, etc.). Specifications and drawings should indicate type of ventilation facilities to provide clean, dry, and whenever possible, filtered air circulation. It is also important to indicate dimensional separation between transformer units and between transformers and adjacent walls or partitions.

Noise level is another basic consideration where dry type units are to be installed in areas where the inherent transformer hum might be objectionable. For that reason decibel level of transformer operation has become an important selection factor. Modern transformer design has reduced noise to a practicable minimum. Where noise is a paramount consideration, it should be so noted in a specification and selection and installation of equipment made accordingly.

Placing transformers at an angle (rather than parallel) to walls or partitions often reduces the intensity of reflected noise. Where such an arrangement is not possible, addition of sound-absorbing material to walls and partitions is sometimes provided. Where either or a combination of these techniques is indicated in the design, the specifications should so state.

Where a number of small single-phase transformers are used on a feeder to provide utilization voltages for lighting, receptacles, etc., specifications should clearly indicate that the primary connections of such units should be balanced on the 3-phase feeder circuit.

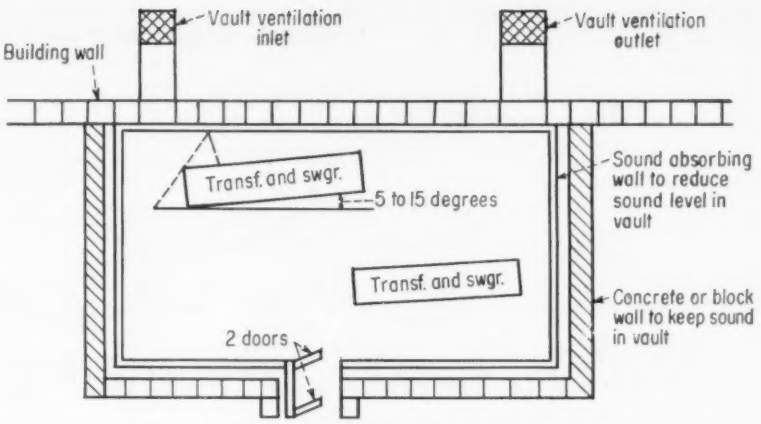
System design considerations affecting transformer installation should be reflected in the specifications. A transformer specification may be contained in a single paragraph or group of clauses; or it may consist of a related series of numbered or itemized statements. In either case, such statements or clauses should be explicit. A complete specification could cover any or all of the following detailed information. Examples of typical clauses are shown in boldface type in following paragraphs.

3.1 Application

Cover intended use, purpose, relation to other sections of the system.

3.11 Main transformer

Where utility primary service is stepped directly to desired utilization level, as in a simple radial distribution system.



Vault layout to break up direct reflections and standing waves. Door air lock on outside of roof.

1- Important features.

A. Air conditioning equipment in separate room.
B. No building ventilating ducts passing through transf. vaults.
C. Conduits sealed to walls with sound absorbing materials rather than "cemented in."
D. Doors of tight construction (no air passage around doors).
E. Ventilating ducts lined or baffled if opening on to quiet street or area way.

NOISE CONTROL METHODS to attenuate objectionable transformer hum should be indicated in plans and in specifications. Here, vault construction features and equipment location combine to reduce noise level.

3.12 Master station

Generally supplied by primary service conductors, with secondaries in turn supplying two or more transformer substations located in various parts of the customer's premises. A typical general clause may be as follows. This should be supplemented by relevant equipment clauses.

Master station shall be designed for (outdoor or indoor) installation. It shall consist of transforming and coordinating combinations of high-voltage and low-voltage switchgear, installed in accordance with the feeder diagram and at the location shown on the plans.

3.13 Load center substation

Where in-plant distribution voltage is stepped to utilization level near center of electrical load. Transformer may be separate unit or integrated with a unit substation (See Section 4.0—Unit Substations 4.4)

3.14 Local transformer

For specific application; located as close as possible to that item or application, such as lighting installation, individual motor or group of machines, bus structure for small tools, etc. Indicate phase characteristics of units and balance connection to feeder.

3.15 Special transformers

For applications other than normal power, lighting and heating; such as X-ray and high-frequency use, low voltage for remote control or signal systems, electric furnaces, electric discharge lighting, hazardous locations, current transformers, etc.

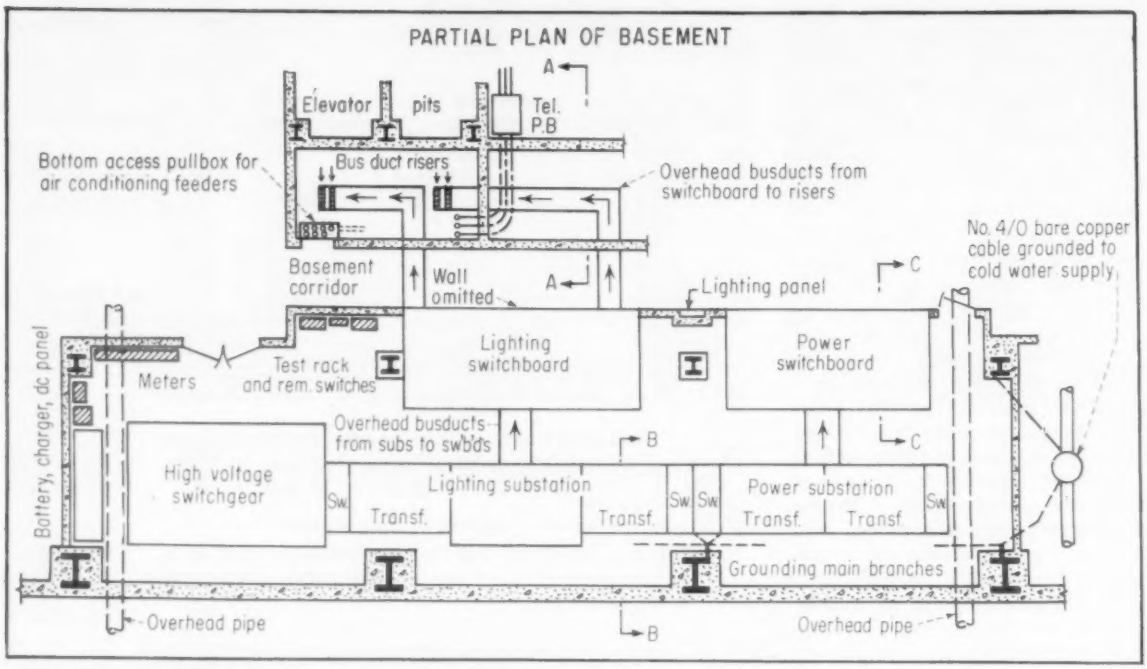
3.2 Characteristics

3.21 Nameplate data

Rated kva, frequency, primary and secondary voltages, percent taps, manufacturer, serial number, style, form, polarity, impedance. If pertinent, add decibel level.

3.22 Characteristics

Transformer shall be rated for —/—kva, oil insulated (noninflammable liquid filled, air cooled, etc.), 3-phase 60 cycles, —volts delta primary, —volts wye secondary, with solidly grounded neutral. High voltage windings shall be provided with 2½% taps, two above and two below normal, externally operated manual tap changer handle arranged for padlocking in each position. Taps may be changed only when transformer is de-energized. They provide means for adjusting to average supply voltage.



PLAN OF BASEMENT VAULT in skyscraper office building shows alignment of 13.2 kv incoming service equipment, transformers with primary interrupter switches and secondary breakers, and bus connections to lighting and power switchboards.

Automatic tap-changing equipment for operation under load shall be installed on low voltage side to maintain constant voltage on low voltage terminals (or some point on the feeder).

Transformer shall be type—as manufactured by the —— Company, or approved equal.

3.23 Wet

(Insulating liquid; oil)

3.24 Dry

Air cooled: natural convection, fan-forced.

Sealed: inert gas filled.

3.3 Construction

3.31 Switches

Primary and secondary disconnecting mediums, connections for parallel operation (secondary ties).

3.32 Bus structure

Primary and secondary, copper or aluminum.

3.33 Enclosure

Gas and oil sealed tank shall be equipped with drain and sampling valves, filter press connections, magnetic oil gauge with alarm contacts, relief diaphragm, ground block and top-oil dial type thermometer. It shall also have nameplate, delta-wye terminal board, neutral bushing, provision for future addition of automatically controlled fans to give continuous overload rating of — kva.

3.34 Related instruments

Voltage transformation section shall include contact-making voltmeter, line-drop compensator and necessary auxiliary control mounted on a hinged steel panel within the unit substation. A rotary switch for selecting automatic or manual control shall be provided. Current transformer for line-drop compensator shall have — amp secondary and be located under oil in the transformer. Potential for the contact-making voltmeter shall be obtained from a potential transformer in the switchgear, and power to drive the mechanism obtained from the switchgear control power transformer. An operation counter and position indicator shall be included. Reactance portion of the line-drop compensator shall be provided with a reversing switch for parallel operation with other units.

3.35 Alarm system

Temperature alarm system—visual, audible or both—to signal transformer overheating.

3.36 Related sections

(See Section 4.0—Unit Substations)

3.37 Details of accessories

Bushing, core and coil details.

High voltage bushings shall be stud (pothead, wiping sleeve, etc.) type, cover (or sidewall) mounted. Low voltage bushings shall be stud (etc.) type, cover mounted. All bushings shall have suitable gaskets to provide a tight fit. Individual high-voltage and low-voltage coils shall be wound on separately formed barriers in order to facilitate removal of the coils in case of repairs being required. Windings shall consist of copper (or aluminum) coils suitably insulated, thoroughly dried and vacuum treated. Core shall be manufactured of high-grade non-aging sheet-steel laminations, properly annealed, treated and insulated from each other in accordance with approved practice.

These transformers shall be guaranteed against load and total losses, and the limiting dimensions and net and shipping weights; also the regulation at 100% and 80% power factor shall be given. Testing shall conform to ASA transformer standards, and units must meet all ASA acceptance tests.

3.4 Location

Indicate transformer location, with dimensional details if necessary. Check local utility regulations.

3.41 Outdoor

Give explanatory clauses describing outdoor installation. Cover such features as: (pole mounted, roof, fenced,

concrete pad, external wall brackets, housed, protected, etc.)

The following is a typical descriptive specification:

The main outdoor transformer station shall include a complete packaged —column switching structure for control of the incoming—kv circuits. It shall have spacing, clearances and mechanical details in conformity with NEMA Power Switching Standards. The structure shall be of galvanized steel (or aluminum), completely shop fabricated with column and trusses assembled, and including bolts for erection, mounting and anchoring; station luminaires, control cable within station.

Also to be included are—kv bus supports and fittings, connectors, conductors, strain, and grounding materials to interconnect the station apparatus. The outdoor station shall also include a concrete pad to support transformers and switchgear (per following specifications).

3.42 Indoor

State how transformers are to be installed (vault, platform or balcony, basement, interior walls, column or truss brackets.)

3.43 Details of housing

Give pertinent information about transformer vault or room (construction, ventilation, drainage, access, type of door, foundation channels, bolting arrangements, service facilities). Add detailed drawings where necessary.

4.0 Circuit Switching and Protection

- ☐ **Circuit Characteristics** —voltage
  - — phase
  - — ampere load
  - — interrupting capacity
- ☐ **Service Entrance Equipment**
  - — primary
  - — circuit breakers
  - — interrupter switches
  - — secondary
  - — circuit breakers
  - — fused switches
- ☐ **Primary Distribution Center**
  - — interrupter switches, number and size
  - — circuit breakers, number and size
  - — type of equipment enclosure
  - — associated wiring and connections
- ☐ **Unit Substation**
  - — primary and secondary disconnect
  - — transformer type and rating
  - — low voltage section
  - — number, type and size of units
  - — substation construction
  - — type and arrangement of enclosure
  - — instrumentation
  - — bus and connection data
  - — circuit tie and interlocking
- ☐ **Control Center or Switchboard**
  - — main disconnect
  - — type, size
  - — branch circuit units
  - — number, type and size
  - — construction
  - — type and arrangement of enclosure
  - — bus and connection data
  - — metering or instrumentation details, if any
- ☐ **Panelboards — Power and Lighting**
  - — size and arrangement of main bus
  - — number of branch circuit devices
  - — circuit breakers
  - — fuse and switch assembly
  - — size and number of poles of each
  - — enclosing cabinet and trim, doors and locks
  - — flush — surface
- ☐ **High Frequency Lighting Panels** — need for detailed specification clauses
- ☐ **Safety Switches**
  - — type and size
- ☐ **Fuses**
  - — size and type
  - — one time
  - — renewable
  - — time delay
  - — number of spares
- ☐ **Other items** dictated by specific project

Circuit switching and protection begins at the service entrance and continues down through the branch circuits with equipment provided at each division of the complete electrical system.

Such equipment is generally covered in electrical specifications by descriptive paragraphs or clauses which supplement riser diagrams and detailed drawings on the plans.

With the increased application of high-voltage in-plant distribution, it is logical to group circuit switching and protection equipment into two classifications: primary (2.4 kv to 13.8 kv, etc.); and secondary (under 600 volts). This is in line with similar divisions noted in Section 2.0 Service Entrances and Section 5.0 Feeders. Thus a complete primary and/or secondary distribution system specification can be developed by selecting applicable clauses from these various specification sections.

When switchgear is to be used as service entrance equipment fed by networks and serves high capacity, low impedance electrical systems, interrupting capacity is an important design and specification characteristic. Whenever the interrupting capacity of conventional equipment is likely to be

exceeded under any possible conditions of failure, accident or malfunction, the design engineer should make a precise analysis of the system impedance, and the available short circuit or fault currents. Such an analysis is reflected in the selection and specification of switching and protection components.

Depending upon design concept, circuit switching and protection equipment may be designated as:

a. Individual enclosed externally operable switch and fuse (or circuit breaker) items; or a group of enclosed fused switches (or circuit breakers).

b. Assemblies of fused switches (or circuit breakers) in a single enclosure, such as distribution and branch circuit panelboards.

c. Totally enclosed, free-standing, metal clad switchgear such as a distribution center, load center or motor control center.

All circuit disconnect and protection item specifications should include the following information: voltage, phase, number of poles, rating of overcurrent devices, and interrupting capacity (if required).

Where distribution and branch circuit panelboards, load centers, or switchgear are involved specify the number, type (copper or aluminum) and capacity of main bus bars; rating (as above) and type (fused switch or circuit breaker) of main disconnect; the number (quantity), rating (as above) and type (fused switch or circuit breakers) of branch circuit devices; plus the number of spare units or spaces to be included in the assembly.

This information may be presented in descriptive form, or by simply indicating a manufacturer's catalog number if the selected equipment is a standard catalog item.

4.1 Service Entrance Switches

Service entrance equipment may be installed separately or in combination with switching centers or distribution panelboards or switchboards. Clearly indicate on the plans and in the specifications which type is intended and include pertinent descriptive information.

4.12 Primary service equipment

a. Interrupter switches

b. Circuit breakers

Indicate manufacturer's name, type number or other identifying designation. Specify type and style of enclosure (indoor or outdoor) and type of conduit or cable entrance and exit fittings; electrical data on enclosed equipment.

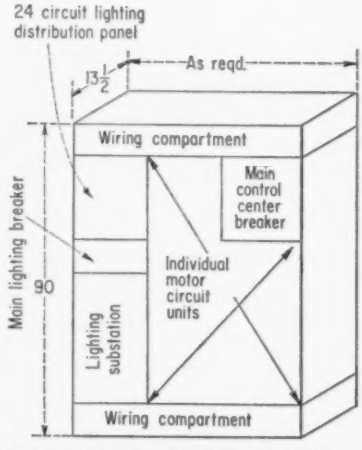
4.13 Secondary service equipment

a. Fused switch: The electrical contractor shall furnish and install where shown on the plans a — amp, — volt, — pole (solid neutral) fused switch in a NEMA Type — enclosure as a service entrance disconnect. Switch shall carry UL approval as suitable for use as service equipment.

Switch shall be of the positive action, quick make, quick break type with interlocking cover that prevents opening door when external handle is in "on" position. Switch shall be — Company, Type —, Catalog No. —, or approved equal.

b. Circuit breaker disconnect: The electrical contractor shall furnish and install where indicated on the plans a — amp, — volt, — pole circuit breaker in a NEMA Type — enclosure. Breaker shall be manually operated, trip free and designed so that all poles open simultaneously. Overload tripping mechanism shall be (thermally, magnetically) operated and arranged to provide effective sealing against tampering. Breaker shall be Type —, Catalog No. —, as manufactured by the — Company, or approved equal.

Where service entrance disconnecting means is to consist of two to six switches (circuit breakers) in a common enclosure, as permitted by Section 2351-a of the National Electrical Code, clearly indicate this on the plans and in the specifications. Indicate the voltage, ampere rating and number of poles of each disconnect, fuse or overcurrent protection size, number and size of main bus bars and type of enclosure. If assembly is standard catalog item, give manufacturer's name and catalog designation, or approved equal; if special assembly, show detailed drawings.



COMBINATION CONTROL CENTER permits centralized control of motors and area lighting. Simple drawing shows arrangement of equipment in free-standing housing.

4.2 Panelboards

4.21 Power and distribution type

Where shown on the plans, indicated in the riser diagram, and listed in the panelboard schedule, furnish and install distribution and power panels of the types and sizes noted. Panels shall be installed with top of cabinet — ft, — ins. above floor level.

a. Panelboards shall be of the combination switch and fuse type with dead-front safety construction incorporating (hinged-cover swing out; pull-out; quick-make, quick-break, safety-interlocked, externally operable handle) branch circuit units.

Panel bus structure shall be for — volt, — phase, — wire service and of sufficient capacity to feed the (number) — pole, — wire branch circuit units indicated. Mains shall be equipped with solderless lugs. Branch circuit units shall be of sizes indicated.

Panelboard assembly shall be enclosed in a code gauge steel cabinet with flush (surface type) trim and ample wiring gutters on top, sides and bottom. Cabinet doors shall be equipped with spring (bar) latches (indicate whether locks are required and if all shall be keyed alike and how many keys are to be furnished).

Panelboards shall be Type — as manufactured by the — Company, or approved equal.

b. Distribution panelboards shall be of the dead-front safety type equipped with circuit breaker branches of sizes noted on the drawings or indicated in the panelboard schedule. Unless otherwise noted, breakers shall be 2-pole for single-phase 2- and 3-wire circuits and 3-pole for 3-phase 3- and 4-wire circuits. Neutral conductors shall be connected to the common neutral bus. Breakers shall be of the (thermal-magnetic, magnetic-hydraulic) type.

Panel bus structure shall be for — volt, — phase, — wire service and of sufficient capacity to feed the number of branch circuit breakers indicated. Main bus bars shall be equipped with solderless lugs.

Panelboard assembly shall be enclosed in a code gauge steel cabinet with flush (surface type) trim and ample wiring gutters on top, sides and bottom. Cabinet doors shall be equipped with spring (bar) latches (indicate whether locks are required and

if all shall be keyed alike and how many keys are to be furnished with each panel.)

Panelboards shall be Type — as manufactured by the — Company, or approved equal.

4.22 Lighting panelboards

All lighting branch circuit panelboards shall be of the (switch and fuse, circuit breaker) type of sizes listed in the panelboard schedule or noted on the drawings. Panels shall have mains only with solderless lugs on the main bus bars and shall be arranged for service on a — volt, — phase, — wire system.

a. Branches shall have approved molded block single-pole snap switch units with plug fuse holders.

b. Branches shall have single-pole, magnetic-hydraulic circuit breakers of sizes noted.

Cabinets for lighting panelboards shall be of code gauge steel with ample wiring gutters for all wires and connections. Doors shall be the single type (unless otherwise noted) with spring latches (note if locks are required, if they should be keyed alike, and how many keys should be furnished for each panel). Panel trim shall be furnished for flush (surface) mounting as noted.

Panelboards shall be Type — as manufactured by — Company, or approved equal.

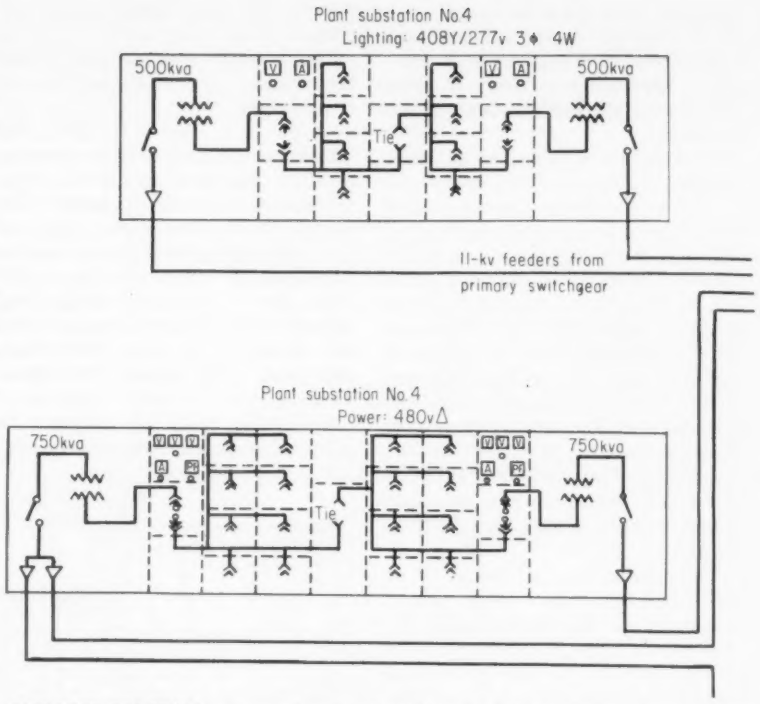
When lighting panelboards are to be of the narrow, single-row construction for mounting in the channel of H or I beams, so indicate on the plans and in the specifications. Include the necessary pull box containing the neutral bar and required wiring duct to connect column panel with pull box above.

4.23 High frequency lighting panel

Lighting distribution panels for high frequency lighting systems differ from conventional panels and must be tailored to the specific type of system installed. Circuiting from the frequency converters have a definite bearing on panel arrangement. Until electrical components for new distribution concepts, such as this, become standard catalog items, it is advisable to be more detailed and explanatory in specification clauses and to provide detailed drawings of components.

A specification clause for a single high frequency lighting panelboard for a two-converter system might read as follows:

Furnish and install a (manufacturer's name), or approved equal, two-



ONE-LINE DIAGRAM of partial unit substation distribution system shows various points at which circuit switching and protection equipment devices are involved in the system design.

section, — circuit panelboard for the — cycle, — volt lighting system where indicated on the plans. Panel shall be rated — volts line-to-ground, and — cycles.

The top section of the panel shall contain (number), — amp, 2-pole, — volt circuit breakers with bus connections arranged so that each phase of the 3-phase, 6-wire, — cycle feeder from one converter feeds — branch circuit breakers. Converter conductors shall be connected to a terminal block at the top of the panel.

The bottom section of the panel shall be a duplicate of the top section with terminal block at the bottom to receive conductors from the other converter.

A steel barrier shall separate the two panel sections.

Each 2-pole branch circuit breaker shall control (number) high frequency lighting fixtures as shown on the plans.

Panel shall be of the dead-front, safety type with a code gauge sheet metal cabinet and hinged door with spring latch and suitable lock.

4.3 Primary Distribution Center

The electrical contractor shall (furnish), receive, install and connect the complete — kv switching center in the — as indicated on the drawings. The assembly shall consist of (number) free-standing metal (steel, aluminum) cubicles, each containing a (fused interrupter switch, circuit breaker) of capacity noted on the drawings.

Cubicles shall be of (indoor, outdoor) type and shall be set on and securely fastened to leveled structural steel members as indicated on the drawings. Connections to the service transformers shall be made with (conduit and cable) (high voltage bus) as noted. Feeder cable connections shall be made to terminals provided in each cubicle.

The electrical contractor shall also furnish and install a complete lighting system for the switching center as noted on the drawings and furnish and install necessary conduits for power company's metering circuits. All work shall meet with (utility company, owner, engineer) approval.

Primary switching units shall be as manufactured by the — Company, or approved equal.

4.4 Unit Substations

The electrical contractor shall (furnish), receive, move, assemble, install and connect the unit substation(s) as indicated on the plans and in accordance with drawings furnished by the manufacturer.

This contractor shall install the necessary level structural channels on

which the units are to be securely fastened; also all connection and pull boxes, conduits, supports and other circuit accessories necessary to make all high voltage and low voltage connections.

Unit substation(s) shall be as manufactured by the — Company, or approved equal. Each substation shall consist of an incoming primary section with a — kv (interrupter switch) (circuit breaker); a transformer section with a — kva, ——/— volt, 3-phase, air-cooled transformer; and a low-voltage section containing (number) air circuit breakers of sizes noted for secondary feeders. Also necessary tie-breaker, metering and transition cubicles as indicated.

All connections, devices and instruments shall be checked thoroughly for proper operation before the unit is energized.

Unit substations must be tailored to the specific electrical system design with respect to transformer rating, and number and sizes of secondary circuit control devices. A typical detailed equipment specification for a specific unit substation might read as follows:

The secondary selective unit substations shall be rated 750/1000 kva, 3-phase, transforming from 4160 volts to 480/277 volts. They shall be arranged in sections of same height and depth.

Each substation shall consist of the following:

a. One incoming section with a 5-kv, 3-pole, single-throw, gang-operated dry type load break switch integral with the transformer.

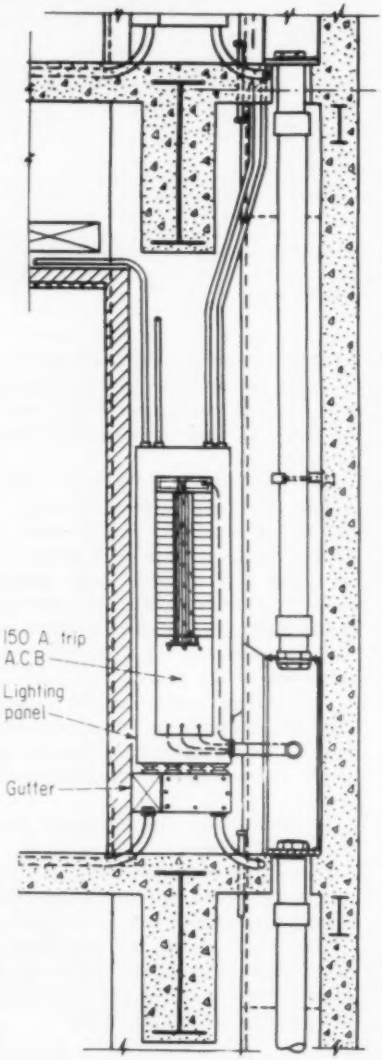
b. One transformer section with a 750/1000 kva, 3-phase, 60-cycle, 4160 volt delta, 277/480 volt wye, air-cooled type natural draft, 80° C rise, with four 2½% full capacity taps (two above and two below normal primary voltage), necessary insulated 5-kv bus, bare 600-volt bus and ground bus complete with connections and supports. Forced air-cooling equipment facilities shall be provided to obtain 33% greater capacity. This equipment shall be automatically controlled from winding temperature devices.

c. One main breaker section with stationary and removable elements, primary disconnecting devices and mechanical interlocks complete with one main air circuit breaker of proper capacity for substation rating, and tie air circuit breaker of proper rating for transfer of 50% of substation rating, each draw-out type, triple-pole, single-throw, electrically-operated, rated 600 volts, 60,000 rms amp interrupting capacity respectively with three time-over-current and instantaneous trip coils.

One ammeter, one voltmeter, transfer switches, potential and current transformers.

d. Two feeder breaker sections with stationary and removable elements, primary disconnecting devices and mechanical interlocks complete with six (6) air circuit breakers, draw-out type, triple-pole, single-throw, manually operated, rated 500 amps, 600 volts, 30,000 rms amp interrupting capacity with three time-over-current and instantaneous short circuit trip coils and two spaces for future breakers.

Substations shall be arranged in pairs and equipped with secondary selective devices to operate as follows: Upon loss of bus voltage on one substation, its main breaker shall open and its tie breaker and the breaker of the second substation shall close automatically. When bus voltage is restored, the main breaker shall be closed manually thereby opening both tie breakers.



Typical Electric Closet

PANELBOARDS frequently must be specified to meet structural limitations. Details like this simplify installation problems.

4.5 Switchboard

Switchboard shall be the dead-front safety type consisting of panels housing circuit breakers (switch and fuse assemblies) of the number and sizes shown on the drawings. The board shall consist of a rigid structural or formed steel (aluminum) frame which shall maintain its alignment and not be damaged in shipment or erection or by stresses resulting from short circuits. Frame shall be completely enclosed on front and sides with sheet steel (aluminum) plates. Adequate ventilation shall be provided.

A pull box of the same type construction shall be provided at the top of each switchboard and shall match the switchboard in dimension and finish. Bottom of pull box shall be non-combustible insulating material with openings for cables to circuit breaker (switch and fuse assembly) studs. Switchboard shall be sectionalized to permit access to the breakers (switch and fuse assemblies).

Buses on switchboard shall be of hard drawn copper of 98% conductivity (or aluminum). Connections shall be bolted and laminations interleaved to secure maximum contact areas. All buses and disconnect stub connections shall be of such size as to limit the temperature rise to 30° C. when carrying full-load current at room temperature, but not to exceed a current density of 1000 amps per square inch.

Switchboard shall be as manufactured by the — Company, or approved equal.

4.6 Control Center

The electrical contractor shall furnish and install a centralized control center of the self-supporting, totally-enclosed metal (steel, aluminum) type consisting of standard modular dimension units as noted on the plans.

The complete control center shall contain main disconnect, branch circuit breaker and combination line starters, and circuit breaker disconnects of size and type and voltage noted on the drawings. Where required, start-stop and reset buttons shall be provided in the cover of each motor starter section.

Control center shall be furnished complete with necessary pull boxes, wiring gutters, assembled copper (or aluminum) bus connections, terminal blocks and all required control features.

All motor starters and branch breakers shall be (front, back-to-back) mounted and shall be easily accessible for maintenance, repair or replacement.

Control centers shall be as manufactured by the — Company, or approved equal.

4.7 Safety Switches

The electrical contractor shall furnish and install all (fusible, not fusible) safety switches of sizes noted on the drawings. All switches shall be heavy-duty Type A, quick-make, quick-break, in NEMA Type 1 general purpose enclosure with interlocking cover, unless otherwise indicated. Switches shall be as manufactured by the — Company, or approved equal.

4.8 Fuses

Fuse protective devices for circuits not over 125 volts to ground and not over 30-amp capacity shall be of the plug type so designed as to be subject to tampering only with difficulty.

Fuses shall be:

a. One time, standard type.

b. Time delay type; capable of holding 200% load for 10 seconds.

All other circuits shall be protected by cartridge fuses (one time, renewable).

Fuses shall be of the correct capacity to protect the circuits as shown and for the voltage specified.

a. Of standard type, accurately rated as indicated.

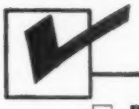
b. Time delay type.

Spares amounting to one-half of a duplicate set of those installed shall be turned over to the owner upon completion of the work.

Use of time delay fuses should be considered for circuits serving motor, appliance or other services subject to momentary or variable loads of relatively short duration.

For loads above 600 amps to 5000 amps and for very high interrupting capacity below 600 amps consideration should be given to the use of high-interrupting-capacity fuses employing silver links in a chemically inert filler. These fuses are of special design and are bolted in place. Short circuit arcs tend to fuse the inert material, quickly dissipate the energy, and block the flow of current.

5.0 Feeders



- ☐ **Bus Duct or Bus Assembly** — size, type, voltage, phase, No. of conductors
- ☐ **Classification of Feeders** — voltage and phase
  - — primary — over 600 volts
  - — secondary — 500 volts and less
  - — high frequency — cycles and voltage
- ☐ **Conductors** — type (insulation), size, voltage
  - — aerial cable, self-supporting
  - — armored cable
  - — concentric or coaxial cable (hi-cycle systems)
  - — multi-conductor assembly
  - — single conductor
  - — open wiring
- ☐ **Feeder Schedule** — from — to, feeder No., raceway type, type and size of cable, length
- ☐ **Installation** — as noted on plans

  Overhead
  - — conduit (metal, plastic, etc.)
  - — aerial cable supports
  - — cable troughs, wireways, ladder racks, etc.
  - — open wiring construction (indoors)
  - — pole line construction

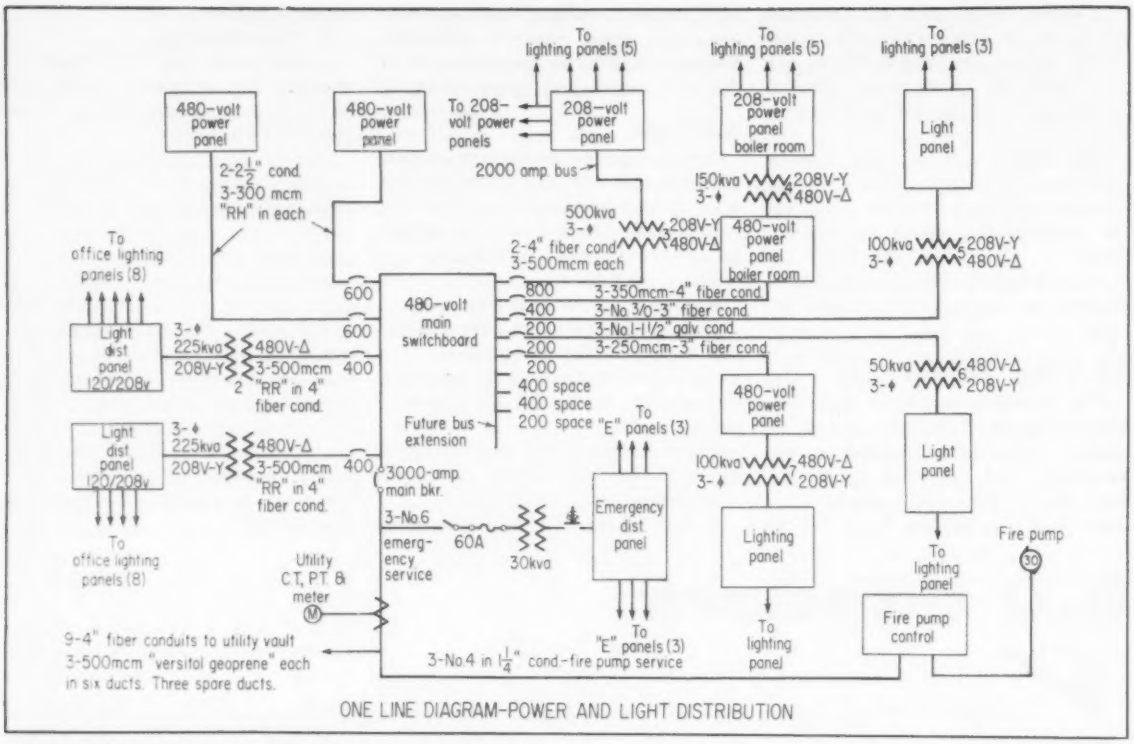
  Underground
  - — direct burial cables
  - — ducts (conduit — metal, fibre, asbestos-cement, tile, etc.)
  - — protection (concrete envelopes, creosoted planks, sand fill, conduit ells, etc.)
- ☐ **Routing of Feeders** — parallel to lot and building lines, clearances from other systems, etc.
- ☐ **Structures** — cable support, pull and splice boxes
  - — duct manholes
  - — special raceway supports
- ☐ **Terminations** — methods
  - — at switchgear, etc.
  - — at manholes
  - — splices and taps
- ☐ **Supplementary items** dictated by the specific project design

Electrical distribution feeder systems can be divided into two general classifications: Primary and Secondary.

Primary feeders connect a main high voltage (over 600 volts) switching center with one or more transformer banks or unit substations which step down to utilization voltage levels.

Secondary feeders (600 volts or less) normally originate at a main low-voltage switchboard or unit substation section and terminate at a branch circuit distribution panelboard or load center with no further reduction in voltage level.

Good engineering practice demands that feeder design take into consideration electric demand, voltage drop and spare capacity for future system expansion. This is reflected in the plans and specifications. It is important to proper installation and system operation that all feeders be identified in the plans and specifications with pertinent information regarding size, voltage, insulation, supporting raceway, routing,



ONE LINE DIAGRAM-POWER AND LIGHT DISTRIBUTION

ONE-LINE DISTRIBUTION DIAGRAM for medium size plant shows cable and raceway type and size of all feeders. Multiple utilization voltages are obtained through local transformers.

installation and termination details.

Such information can be clearly listed in capsule form in a Feeder Schedule included on the plans or in the specifications. Schedule headings can be (reading from left to right): From—To; Feeder No.; Raceway type and size; Cable type, size, voltage, number of conductors; Length; and if necessary, pull, splice and cable support boxes. If the feeder distribution system is extensive, feeder specifications can be divided into primary and secondary sections with separate schedules for each.

Physical characteristics of electrical feeders depend upon the design requirements of the specific project. Feeders may be conduit and cable, armored cable, aerial cable, bus duct, etc. Clearly indicate with appropriate specification clauses, the physical composition, or "wiring method" pertaining to each feeder or group of feeders; plus definitive statements relating to transition from one type to another.

One method of developing a feeder specification is to start with a general description of the feeder system for the specific project, then add supplementary clauses covering individual components of the complete system as required by the design. The format of this Section is designed to facilitate such an approach, with typical specification clauses appearing in boldface type.

5.1 Classification

5.11 Primary feeders

The electrical contractor shall furnish and install a complete —— volt, —— phase, —— wire primary feeder system from the —— volt switching center to all unit substations as shown on Drawing No. ——. Types and sizes of individual feeders shall be as indicated in the Feeder Schedule on the drawings (or in the specifications).

Add relevant supplementary clauses covering material items, installation methods, etc., to make a complete specification.

5.12 Secondary feeders

Secondary electrical distribution within the building (or plant) shall be ——/—— volt, —— phase, —— wire for combined power and lighting. The electrical contractor shall furnish and install all feeders from the main switchboard (or unit substation sections) to the various distribution cabinets (or load centers) as shown on the plans (Drawing No. ——).

Feeders shall be of the types and sizes indicated in the accompanying Feeder Schedule (Drawing No., or specification reference).

Add relevant supplementary clauses covering material items, installation methods, etc., to complete the system specification.

If the design calls for separate feeders for power and lighting make this clear in the specifications and on the plans.

5.2 Underground System

5.21 Ducts and cables

The electrical contractor shall furnish and install a complete underground distribution system for the —— volt, —— phase, —— wire feeders shown on Drawing No. ——. He shall be responsible for all excavating, draining trenches, forming of duct assembly and protective concrete envelope, backfilling and removal of excess earth.

Ducts shall be (steel, fibre, asbestos-cement) conduits of sizes noted on the plans and in the Feeder Schedule. Ducts shall be as manufactured by (company), or approved equal. All duct joints shall be waterproofed according to manufacturer's recommendations.

All underground conduits shall be encased in a —— in. by —— in. concrete envelope of ——-——-—— mix and arranged in tiers as noted on the duct bank cross-sectional drawing.

Ducts shall be installed below normal frost line at least —— in. below finished grade (at least —— in. below grade for high voltage feeders). Banked conduits shall be held securely in place, at a minimum —— in. spacing between conduits, by approved separators installed at 5-ft intervals.

Where the concrete duct envelope crosses roadways, soft fill or other utility mains, it shall be reinforced with ——-in. steel reinforcing rods as shown in the duct cross-sectional drawing. Reinforcing shall extend —— ft beyond area requiring additional protection.

Ducts shall be installed with a 3-in. per 100-ft. downward slope from buildings or section high points toward manholes which are to be provided with drainage facilities.

Conduit terminations at manholes and building walls shall be with end-bells suitable for the type of duct installed. Spare conduits noted on plans shall be provided with a No. —— galvanized steel drag wire. All ducts shall be swabbed clean before cable installation. Spare ducts shall be plugged at both ends and conduits containing cables provided with a water-tight seal after cable installation.

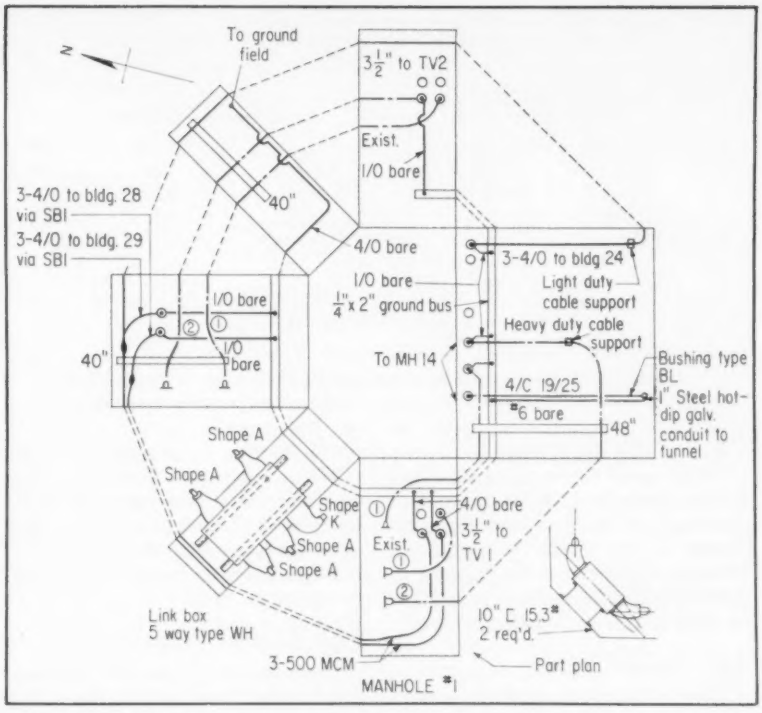
Manholes shall be of the size and type indicated on the drawings. Cables shall be trained in manholes and supported on racks and hooks as indicated. The electrical contractor shall furnish and install all inserts, racks and supports necessary.

5.22 Direct burial cables

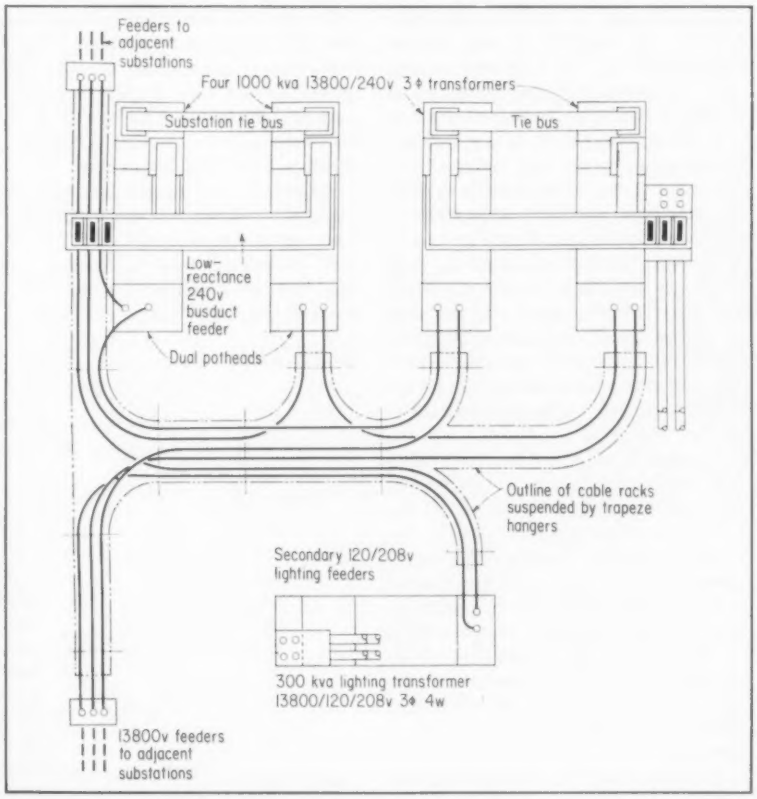
Underground feeders of direct-burial cable type, where noted on the plans, shall be (company), (trade name), Type ——, or approved equal, with a —— conductor insulation and overall —— moisture-proof jacket.

Single-conductor (or multi-conductor) cables shall be of sizes indicated in the Feeder Schedule and shall be installed not less than —— in. below finished grade. Cables shall rest on and be covered with a —— in. layer of sand to prevent cable damage from sharp objects in the fill. Additional protection at points noted on the drawings, or specified herein, shall be provided by installing creosoted planks between cable sand and trench fill.

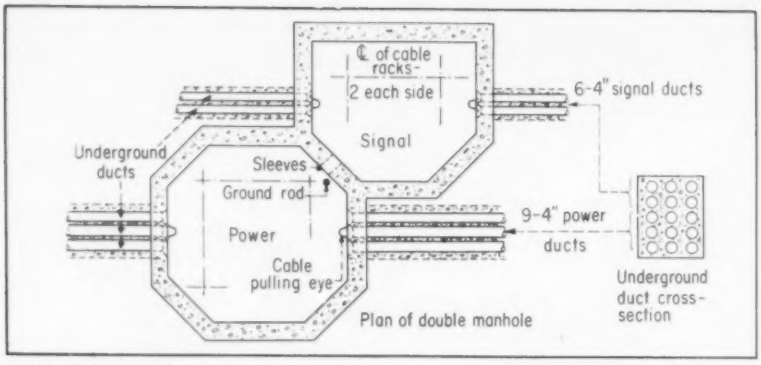
All cables shall enter manholes, building walls, or termination points through a protective galvanized steel conduit sleeve of appropriate size. Open end of sleeves shall be provided with a moisture seal after cable is installed. Seal shall be type approved for system voltage and cable insulation.



EXPLODED VIEW of an underground feeder manhole details duct entrances, cable racking, grounding system, mounting of primary cable boxes (described in specifications); gives contractor clear picture of complete manhole installation.



PHYSICAL ARRANGEMENT of primary feeders on cable racks and secondary bus duct and conduit feeders at a substation location. Drawings like this supplement good specification clauses and eliminate misunderstandings in the field.



DOUBLE MANHOLE plan view shows underground duct arrangement for power and signal distribution with composite duct bank arrangement between manhole locations.

5.3 Conduit Raceways

Where noted on the plans, overhead feeders shall be installed in conduit raceways of the sizes and types indicated in the Feeder Schedule. All conduits shall be securely fastened to building structure and run parallel or at right angles to building walls.

5.31 Conduit type

Raceways shall be (describe protective coating and finish) heavy-wall, rigid steel (or aluminum) conduit as noted on the plans or specified herein. Steel conduit shall be manufactured of mild steel tube of uniform thickness and smooth circular bore and shall be approved for use as an electrical raceway. Conduit shall be furnished in standard 10-ft lengths free of defects.

Conduit ends shall be cut square, threaded and reamed to remove burrs and sharp edges. Field threads shall be of same type and have same effective length as factory cut threads.

Conduit joints shall be made with approved couplings or unions. Bends and offsets shall be made with a hickey or power bender without kinking or destroying the smooth bore of the conduit. Paralleled conduits shall be run straight and true with offsets uniform and symmetrical.

Conduit terminals at boxes and cabinets shall be rigidly secured with locknuts and bushings as required by the NEC and local electrical code. Insulated bushings shall be used on all conduit 1¼-in. trade size and larger.

Where riser conduits, accessible to unauthorized personnel, contain feeders above 600 volts, conduits shall be encased in a —— in. concrete envelope, or other approved protective means, for a distance of —— ft above floor level.

Conduit shall be as manufactured by the —— Company, or approved equal.

Insulated bushings shall be (company), Type ——, or approved equal.

Where feeders are subject to highly corrosive atmospheres, as noted on the plans, conduit shall be (plastic-coated, or other corrosion-resistant type) as manufactured by the —— Company, or approved equal.

5.32 Conduit supports

Exposed conduits shall be securely fastened in place or not more than 5-ft centers; and hangers, supports or fastenings shall be provided at each elbow and at the end of each straight run terminating at a box or cabinet.

Horizontal and vertical conduit runs may be supported by one-hole malleable straps, clamp-backs, or other approved device with suitable bolts, expansion shields (where needed) or beam-clamps for mounting to building structure or special brackets.

Adjustable hangers may be used to suspend ——-in. or larger conduits when separately located.

If adjustable trapeze hangers are used to support groups of parallel conduits, U-bolt type clamps shall be used at the end of a conduit run and at each elbow. J-bolts, or approved clamps, shall be installed on each third intermediate trapeze hanger to fasten each conduit.

Hangers shall be made of durable materials suitable for the application involved and shall be painted two coats of lead and oil paint. Where excessively corrosive conditions are encountered, hanger assemblies shall be protected after fabrication by sherardizing or galvanizing, special paint or other suitable preservative methods.

The use of perforated iron for supporting conduits will not be permitted.

The required strength of the supporting equipment and size and type of anchors shall be based on the combined weight of conduit, hanger and cables.

5.4 Cable Boxes

The electrical contractor shall furnish and install junction boxes, pull boxes, cable support boxes and wiring troughs as shown on the drawings, herein specified, or otherwise required. All boxes shall be of code gauge steel with screw covers fastened with (corrosion-resistant) machine screws; shall be painted or treated to resist corrosion.

Boxes shall be supported independently of conduits entering them. Brackets, rod hangers, bolts, or other suitable supporting methods may be used.

5.41 Pull and junction boxes

Pull boxes shall be fabricated from No. —— gauge sheet steel, with screw covers held in place by corrosion-resistant machine screws. Boxes shall be furnished and installed where indicated on the plans or where necessary to facilitate cable pulling and splicing. Box size shall be as required by the

QUICK REFERENCE CHART OF SHEET METAL GAUGE

USS Gauge for Sheet and Plate Steel

Gauge No.	Thickness of Steel in Inches	
	Uncoated Sheets	Galvanized Sheets
8	.1644	.1681
10	.1345	.1382
12	.1046	.1083
14	.0747	.0785
16	.0598	.0635
18	.0478	.0516
20	.0359	.0396
22	.0299	.0336
24	.0239	.0276
26	.0179	.0217
28	.0149	.0187
30	.0120	.0157

Note: Due to variation in manufacture, a plus or minus tolerance of approximately 10 percent is generally recognized and allowed by some authorities.

NEC for the number of conduits and conductors entering and leaving it.

Where feeder splices are to be made, box shall be large enough to provide ample work space.

5.42 Cable support boxes

Vertical cable support boxes made of No. — gauge sheet steel shall be furnished and installed where indicated on the riser diagram. Boxes shall have removable screw covers fastened by corrosion-resistant machine screws; shall be large enough to accommodate the feeder conduits indicated and provide ample space to install cable supports in the riser conduits.

Individual two-bolt, clamp-type conduit supports of —— in. by —— in. steel shall be provided for each conduit at floor level. Ends of clamps shall extend sufficiently over opening to provide a firm conduit bracing on the floor.

5.43 Cable supports

Cable supports shall be of the —— type, of a size to fit the number and size of feeder conductors and size of conduit. Supports shall be (company), (trade name), or approved equal.

5.44 Wiring troughs

Horizontal wiring troughs shall be furnished and installed where noted on the plans (over switchboards, for complex offsets and change of direction, in congested locations, etc.). Troughs shall be made of —— gauge sheet steel with —— finish; have screw covers and insulated cross-brackets to support conductors at —— ft intervals.

Troughs shall be of sufficient size to accommodate feeder conduits and cables and provide ample room for installing and training the conductors.

Where indicated, or considered necessary, troughs shall have steel barriers to separate feeder circuits.

All troughs shall be supported from the building structure independent of the conduits entering them.

Feeders in troughs shall be identified by fireproof tags or other approved method. Individual conductors of feeder circuits shall be tied together with cabling twine.

5.5 Accessible Wireways

5.51 Cable trays

Furnish and install a metal (steel, aluminum) cable trough (or tray) system to support cable systems as indicated on the drawings. Troughs (or trays) shall be of the (expanded metal, or ladder) type, —— in. deep and of widths as indicated; shall be furnished in standard —— ft lengths complete with the required coupling accessories, elbows, tees, crosses, branch and reducer sections, and cable drop-out accessories.

Trough (tray) assembly shall be (bracket, rod, etc.) supported from the building structure as indicated on plans, with anti-sway brackets provided where necessary.

Approved cable support means shall be provided at top of long vertical runs. Cables shall be fastened to trough (tray) at —— intervals on horizontal runs.

Where indicated on the plans, provide an approved trough (tray) cover to protect conductors.

Troughs (trays) and all accessories shall be as manufactured by the —— Company, or approved equal.

5.52 Wireways

Where indicated on the plans, approved wireways shall be furnished and installed complete with necessary complement of fittings, connectors and parts. Sizes shall be as indicated on the drawings and installation shall be in accordance with manufacturer's recommendations.

Wireways shall be as manufactured by the —— Company, or approved equal.

5.53 Cable pits and trenches

State clearly in specifications where cables pits or trenches (under switchboards, etc.) are to be installed and method of terminating raceways and feeder cables at such locations.

5.6 Feeder Bus Duct

Furnish and install a system of —— phase, —— wire, low-reactance, interconnected feeder bus duct runs of ampere ratings as indicated on the drawings and listed in the feeder schedule. Duct system shall be complete with necessary cable tap boxes, expansion joints, wall flanges, and switch adapters as noted.

Bus duct runs shall be made up of standard, factory fabricated and assembled sections interconnected by joints designed to maintain rigidity and strength. All sections shall carry the Underwriters Laboratories' label.

Bus bars shall be fabricated from the best grade 98% conductivity pure copper, or aluminum, with silver-plated contact surfaces.

Suitable removable-cover handholes shall be provided at section joints to permit standard high-contact-pressure bolted bus bar connections.

All duct sections shall be furnished with standard hangers as indicated on the plans. All rods, straps, special brackets and other approved means of suspending the duct runs shall be furnished and installed by the electrical contractor.

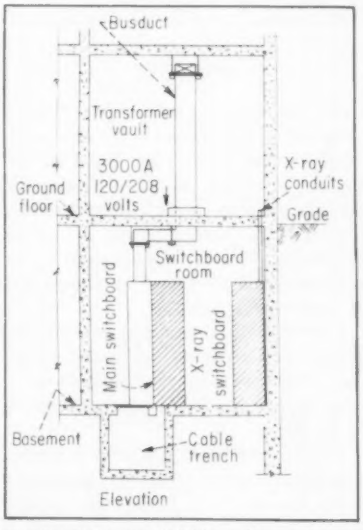
All feeder bus duct shall be —— Company, Type ——, or approved equal.

Where special installation conditions exist, supplement specification clauses with detailed drawings.

CABLE SUPPORT SPACING IN VERTICAL RACEWAYS

Conductor Size	Maximum Space Between Supports—in Feet
No. 18 to No. 1/0	100
No. 2/0 to No. 4/0	80
250MCM to 350MCM	60
350MCM to 500MCM	50
500MCM to 750MCM	40
Above 750MCM	35

A handy reference check on spacing of riser feeder cable supports



ELEVATION DRAWING of transformer and switchboard rooms establishes relative location of switchboard, feeder bus duct and secondary feeder cable trench; simplifies estimating and installation.

Conduit Spacings

SPACINGS IN INCHES BETWEEN CENTERS OF CONDUITS

The light face figures are the minimum dimensions to provide clearance between locknuts.
The more liberal spacings printed in bold face type should be used whenever possible.

Size	½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6
½	1 3/16	...	...	...	...	...	...	...	...	...	...	...	...
	1⅜	...	...	...	...	...	...	...	...	...	...	...	...
¾	1 5/16	1 7/16	...	...	...	...	...	...	...	...	...	...	...
	1½	**1⅝**	...	...	...	...	...	...	...	...	...	...	...
1	1½	1⅝	1¾	...	...	...	...	...	...	...	...	...	...
	1¾	**1⅞**	**2**	...	...	...	...	...	...	...	...	...	...
1¼	1¾	1⅞	2	2¼	...	...	...	...	...	...	...	...	...
	2	**2⅛**	**2¼**	**2½**	...	...	...	...	...	...	...	...	...
1½	1 15/16	2 1/16	2 3/16	2 7/16	2 9/16	...	...	...	...	...	...	...	...
	2⅛	**2¼**	**2⅜**	**2⅝**	**2¾**	...	...	...	...	...	...	...	...
2	2 3/16	2 5/16	2½	2¾	2⅞	3⅛	...	...	...	...	...	...	...
	2⅜	**2½**	**2¾**	**3**	**3⅛**	**3⅜**	...	...	...	...	...	...	...
2½	2 7/16	2 9/16	2¾	3	3⅛	3⅜	3⅜	...	...	...	...	...	...
	2⅝	**2¾**	**3**	**3¼**	**3⅜**	**3⅝**	**4**	...	...	...	...	...	...
3	2 13/16	2 15/16	3 1/16	3 5/16	3 7/16	3¾	4	4 5/16	...	...	...	...	...
	3	**3⅛**	**3⅜**	**3⅝**	**3¾**	**4**	**4⅜**	**4¾**	...	...	...	...	...
3½	3⅛	3¼	3⅜	3⅝	3¾	4 1/16	4 5/16	4⅝	4 13/16	...	...	...	...
	3⅜	**3½**	**3⅝**	**3⅞**	**4**	**4⅜**	**4⅝**	**5**	**5⅜**	...	...	...	...
4	3 7/16	3 9/16	3 11/16	3 15/16	4 1/16	4⅜	4⅝	4 15/16	5¼	5 5/16	...	...	...
	3⅝	**3⅞**	**4**	**4¼**	**4⅜**	**4¾**	**5**	**5⅜**	**5⅝**	**6**	...	...	...
4½	3¾	3⅞	4	4¼	4⅜	4⅝	4⅞	5¼	5 5/16	5⅞	6⅛	...	...
	4	**4⅛**	**4¼**	**4½**	**4¾**	**5**	**5¼**	**5⅜**	**6**	**6¼**	**6½**	...	...
5	4⅛	4¼	4⅜	4⅝	4¾	5	5¼	5 5/16	5⅞	6 3/16	6½	6 13/16	...
	4⅜	**4½**	**4⅝**	**4⅞**	**5**	**5⅜**	**5⅝**	**6**	**6¼**	**6⅜**	**7**	**7¼**	...
6	4¾	4⅞	5	5¼	5⅜	5⅝	5⅞	6 3/16	6½	6 13/16	7⅛	7 7/16	8⅛
	5	**5⅛**	**5¼**	**5½**	**5⅝**	**6**	**6¼**	**6⅝**	**7**	**7¼**	**7⅝**	**8**	**8⅜**

APPROXIMATE DIAMETERS

Locknut ...	1⅛	1⅜	1 11/16	2 3/16	2 7/16	3	3 7/16	4 3/16	4 13/16	5⅜	6	6 11/16	7 15/16
Bushing ...	1	1¼	1½	1⅞	2⅛	2⅝	3 3/16	3⅞	4 7/16	5	5 5/16	6¼	7⅜
Conduit ...	⅞	1 1/16	1⅜	1 11/16	1 15/16	2⅜	2⅞	3½	4	4½	5	5 5/16	6⅝

CONDUIT SPACINGS help establish basic width of pull boxes, troughs, and trapeze type hangers. This handy chart provides a quick reference for engineers laying out such feeder raceway items.

5.61 Weatherproof duct

Where used outdoors, the feeder bus duct shall have a weatherproof finish on the casing and an additional wrap of weatherproof insulating tape on the bus bars. Duct shall bear Underwriters Laboratories, Inc. approval as "suitable for use outdoors."

5.62 Distribution duct

Where bus duct is to be used for distribution to individual electrical equipment, the "plug-in" type should be specified. Typical specification clauses for this type of duct and its accessories are found in Section 6.0 Branch Circuits.

5.7 Armored Cable

Where noted on the plans, (primary) (secondary) feeders shall be of the interlocked armor cable type. Cables shall be —— conductor, —— volt, —— insulation, of sizes listed in the Feeder Schedule. The cable assembly shall be encased in a continuous interlocked spiral metal armor of (steel, aluminum, bronze). Cable shall be as manufactured by the —— Company, or approved equal.

Cables shall be strapped in place on girders and columns, following structural members closely, or supported by cable troughs or ladder racks as noted on the plans.

Troughs, or racks, shall be of (steel, aluminum) construction as manufactured by the —— Company, or approved equal.

The electrical contractor shall furnish and install all brackets or structures necessary to support the racks. Where cables cross open areas, cable troughs or racks shall be suspended by a —— in. steel messenger wire, or suitable catenary structure, as detailed on the drawings.

All cable splices and taps shall be made in approved fittings or junction boxes with cable connectors made up tight to provide a firm mechanical and electrical connection. Conductor connections shall be made with —— type connectors and insulated for the cable voltage.

Conductor terminations shall be made in an approved manner with ——type connectors. All contact surfaces shall be clean.

Primary cables shall be terminated with potheads having voltage and conductor capacity rating of the cables used, or other termination methods recommended by the cable manufacturer. Potheads shall be filled with

compound suitable for the voltage specified and in accordance with manufacturer's recommendations.

5.8 Wire and Cable

5.81 Type and insulation

All wire and cable for feeder circuits shall conform to the latest requirements of the current edition of the NEC and shall meet all ASTM specifications. Wire and cable shall be new; manufactured since (month, year); shall have size, grade of insulation, voltage and manufacturer's name permanently marked on outer covering at regular intervals; shall be delivered in complete coils or reels with identifying size and insulation tags.

Wire and cable shall be suitably protected from weather and damage during storage and handling and shall be in first class condition when installed.

Conductors shall be thoroughly tinned, soft drawn copper (or aluminum, as noted) with flame-retardant braid and covering. Conductor sizes shall be American Wire Gauge sizes with No. 6 and larger of stranded construction, No. 8 and smaller solid. Wire and cable shall be factory color-coded, with a separate color for each phase and neutral used consistently throughout the system. Note the green coding required by the NEC for conductors intended solely for grounding purposes.

Wire and cable shall be as manufactured by the —— Company, or approved equal.

Sizes, insulation and voltage rating shall be as indicated on the drawings and listed in the Feeder Schedule. In general, wires and cables shall meet the following relevant requirements.

Conductors for high-voltage (primary) feeders shall be rated —— volts for the system installed. Insulation shall be —— around conductors with a —— outer covering.

Conductors for low-voltage (secondary feeders) shall be 600-volt, Type RH insulation (or other types, as noted) when installed in permanent dry locations above grade.

All 600-volt feeder conductors in conduits or other raceways encased in basement concrete slabs, slabs resting on fill, installed below grade, or where exposed to moisture or weather, shall have moisture-resistant Type (RW, RHW, TW, AVL, etc.) insulation.

Where noted on the plans, or indicated in the Feeder Schedule, feeders in excessive high-ambient temperature areas shall have Type (AVA, AVB, TA, etc.) insulation.

All conductors for open wiring feeders, as noted on the plans, or in the Feeder Schedule, shall have Type —— insulation (triple braid, Type SB, etc.).

5.82 Aluminum conductors

Where aluminum cables are indicated on the plans and in the Feeder Schedule, conductors shall be insulated aluminum EC grade, semi-annealed, of quality and physical characteristics specifically designed for use in interior wiring systems. Cable shall be of conventional sizes and current capacities as listed in the NEC.

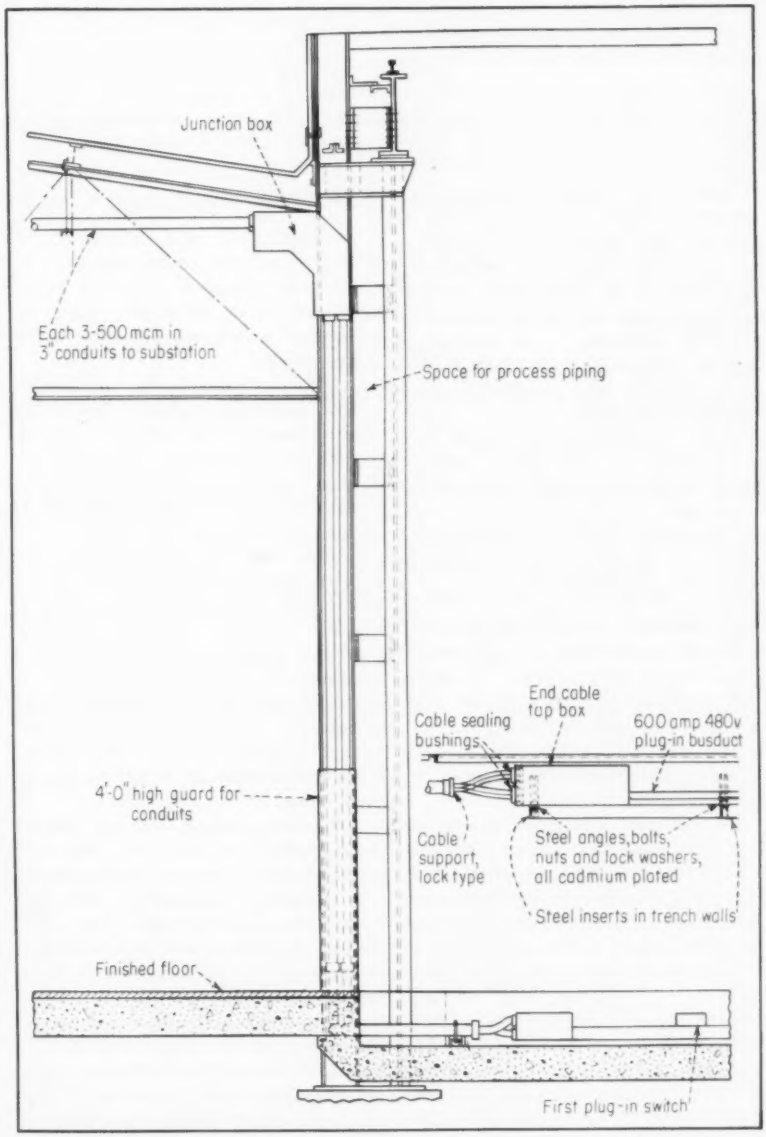
Conductor sizes shall be as noted on the plans and in the Feeder Schedule. Conductor and cable insulation shall be Type ——, as noted.

Wire and cable shall be —— Company, (trade name), or approved equal.

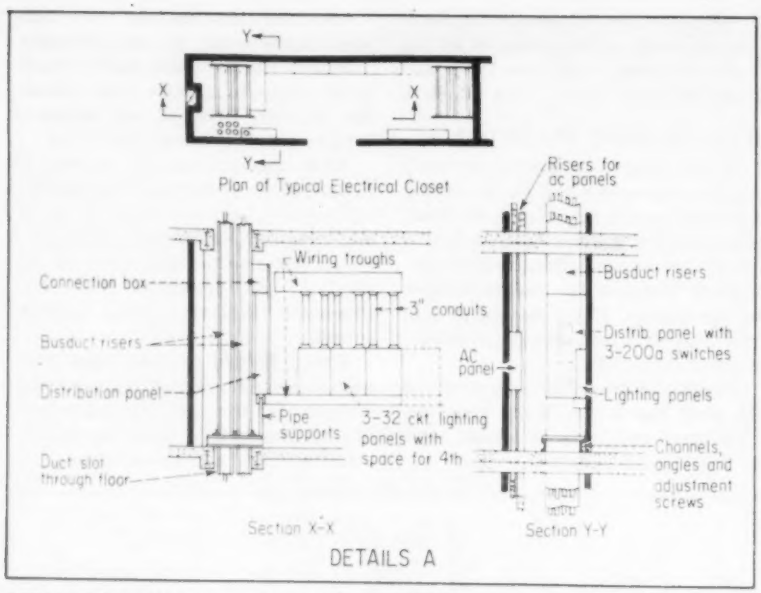
Splices and terminals shall be made in an approved manner with connectors specially designed and approved for use with aluminum conductors.

All conductor ends shall be stripped of insulation carefully to avoid nicking the metal. Approved types of oxide inhibiting compounds containing abrasive conducting particles shall be applied to the conductor and shall thoroughly penetrate spaces between strands.

Where bolted, pressure type connectors are used, they shall be specially designed for use with aluminum conductors and shall be drawn up tight to manufacturers' recommendations.



FEEDER ROUTING where space and protection are important can be detailed in drawings like this showing pull box, conduit guard and transition to bus duct.



DETAIL DRAWINGS like this amplify specification clauses on riser feeder ducts. Plan and elevation views of typical electrical closet show riser supports and arrangement of tap-off to distribution facilities.

Where high compression type connectors are used, they shall be of a type specially designed and approved for use with aluminum conductors. They shall be of exact size to fit the conductors and shall be installed with approved hydraulic tools to bring uniform pressure on all sides of the joint and assure a permanent high conductivity connection.

Where connections are made between aluminum and copper (two dissimilar metals), provision shall be made to prevent electrolytic action.

Connectors shall be (company), Type ——, (catalog number or trade name), or approved equal.

5.83 Detailed specifications

Where feeder cables are to be other than standard building wire with other than standard code designations, it is frequently necessary to include a detailed cable specification. The following is a specification for a self-supporting aerial cable assembly:

The cable assembly shall consist of three single-conductors, each No. 4/0 AWG, 37 x .0756 concentric stranded tinned copper, covered with semi-conducting tape, insulated with ozone resistant butyl base rubber compound to a thickness of 10/64 in., cable and paper tape; 0.005 in. tinned copper shielding tape and covered with a 5/64 in. Neoprene jacket rated at —— volts. The three single-conductors shall be cabled reverse lay and bound to a ½ in. Copperweld messenger with flat copper tape spiralled over the assembly.

5.84 Cable installation

No conductors shall be drawn into conduits until all work which may cause cable damage is completed. Only approved cable lubricants (such as powdered soapstone) shall be used when necessary.

As far as practicable, all feeder cables shall be continuous from origin to panel termination without running splices in intermediate pull boxes or splicing chambers. Sufficient slack shall be left at the terminations to make proper connections.

Unless otherwise noted, each conduit raceway shall contain only those conductors constituting a single feeder circuit.

Where feeders consisting of more than one conductor per phase leg pass through pull boxes or panels, each conductor of one phase shall be grouped together with conductors of the other two phases to reduce reactance effect.

All cable terminals, taps and splices shall be made secure with solderless pressures type connectors, unless otherwise specified. Connectors shall be Type ——, manufactured by the —— Company, or approved equal, and shall be large enough to enclose all conductor strands.

Where compression type connectors are noted on the plans and in the specifications, they shall be of the type as manufactured by the —— Company, or approved equal, and shall be installed with approved hydraulic tools to assure a permanent mechanically secure high conductivity joint.

Where soldered joints are specified, the cable joint shall be mechanically strong before soldering. Solder shall be carefully applied without use of acid. Soldered connection shall be wrapped with (rubber and friction or insulating plastic) tape in manner approved for circuit voltage. Conductor braid shall be cut back so that the insulating tape will bend with the cable insulation.

Where conductors are to be connected to metallic surfaces, the coated surfaces of the metal shall be polished before installing the connector. Lacquer coating of conduits shall be removed where ground clamps are to be installed.

The electrical contractor shall furnish and install all hangers, racks, cable cleats and supports required to make a neat and substantial cable installation in cable chambers, splicing chambers, cable pits and other locations as required. Marlin twine shall be used to bind cable groups together.

5.85 Identification

Each feeder conductor in a pull box or panel shall be identified by metal tag. Tags shall be one inch in diameter and have stamped numbers and letters ¼-in. high.

5.86 High frequency systems

High frequency distribution systems are sufficiently different in electrical and physical characteristics that they should be handled separately from conventional 60-cycle systems on the plans and in the specifications.

High reactance values may be encountered as higher frequencies are used, especially at heavy loadings and frequencies in excess of 1000 cycles. When this occurs, different conductor arrangements and spacings may be used to minimize losses. Normally, concentric conductors or coaxial cables are used to transmit hi-cycle power under these conditions.

When conductors for 1000-cycle systems and up, for large power loads, must be enclosed in a conduit or raceway, the raceways should be of nonmagnetic material because these frequencies would induce excessive eddy current losses in magnetic conduits.

Standard 60-cycle control devices (fused switches, circuit breakers, etc.), when used on high frequency systems, must be derated to prevent excessive heating. Manufacturer's recommendations must be followed.

A separate set of specifications incorporating all the elements of the high frequency distribution system should be developed to supplement the plans.

6.0 Branch Circuits

- ☐ **Bus Duct** — size, voltage, phase, No. of conductors
  - — Plug-in type — plug-in tap-offs, capacitors, ground detectors, etc.
  - — trolley type — mobile or stationary tap-offs
- ☐ **Circuit Characteristics** — amperes, volts, phase, frequency (high frequency)
  - — air conditioning
  - — emergency circuits
  - — heating circuits
  - — lighting
  - — power
  - — special equipment
- ☐ **Conductors** — size, voltage, type of insulation
  - — armored cable (BX)
  - — concentric or coaxial (high frequency) if used
  - — mineral insulated
  - — multi-conductor cables
  - — non-metallic sheathed
  - — open wiring
  - — single conductor
- ☐ **Dimmers** — lighting circuits
- ☐ **Hazardous Location Wiring** — raceways, fittings, accessories
- ☐ **Raceways** — type and size
  - — cellular concrete floor — header ducts and fittings
  - — cellular steel floor — header duct and fittings
  - — conduit — rigid metal, EMT, flexible metal, plastic, plastic coated metal
  - — surface raceways — wireways, troughs, trays, etc.
  - — underfloor duct — metal, fibre — junctions and fittings
- ☐ **Raceway Accessories** — size and type
  - — conduit fittings
  - — outlet boxes — flush, surface type
  - — junction boxes — flush, surface type
- ☐ **Wiring Devices** — amperes, volts, No. of poles

  Switches
  - — push type, toggle, key-operated
  - — 3-way, 4-way
  - — master switch
  - — silent operation
  - — time switch

  Receptacles
  - — single, duplex, triplex
  - — single circuit, split circuit
  - — grounded receptacles
  - — combination 125-, 250-volt, grounded
  - — circuit-breaking type
  - — special purpose
  - — twist tight type

  Plates — switch and receptacle
  - — metal, plastic
  - — single or gang installation
  - — combination switch and receptacle and/or pilot light
  - — flush or surface type
  - — weatherproof
- ☐ **Low-Voltage Switching** — switches, relays, master switches
- ☐ **Supplementary items** dictated by specific project design.

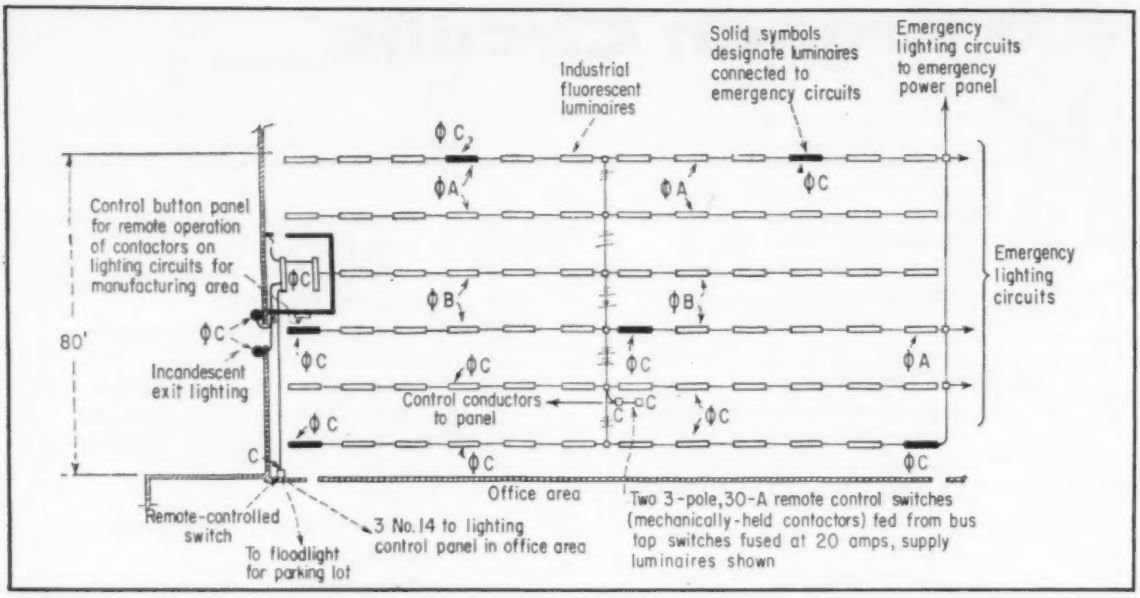
Good engineering practice dictates that branch circuit design, layout and installation receive the same careful consideration as service, feeders and the rest of the electrical system. This means sufficient circuit capacity to take care of known electrical loads, voltage drop, anticipated future loads and spare capacity. Such design characteristics are reflected in the plans and specifications by noting equipment and circuit loads and conductor sizes on the drawings, in equipment schedules, and in relevant sections of the specifications. Estimated loads should be indicated where definite loads cannot be determined.

Type of circuit (single-phase, 2- or 3-wire; 3-phase, 4-wire, etc.) and voltage (110, 115/230, 120/208, 480/277, etc.) should also be noted and mentioned. Where unusual circuiting is involved, unusual conditions exist, or special provisions are to be made, detailed drawings and separate specification clauses should be developed.

Flexibility of branch circuit accessibility and availability are other design factors which should be covered in the plans and specifications. Normally such features are reflected in the circuit distribution design. Specifications and plans should clearly indicate routing of circuits and method of support (conduit, wireways, plug-in bus duct, trolley duct, underfloor ducts, cellular floor cells, etc.). Specific types of branch circuit components and wiring devices to be installed should also be noted in the specifications.

One approach to developing a branch circuit specification for a specific project is to start with a general type clause (noted below); then add relevant component clauses selected from the typical examples presented in bold-face type throughout this section.

The electrical contractor shall furnish and install all raceways and conductors (of type noted), outlet boxes, wiring devices, fittings, and necessary supporting facilities for all branch circuit systems as indicated on the plans and in the specifications. Equip-



PARTIAL PLAN OF PLANT AREA general lighting shows fixture locations, branch circuiting and area control through magnetic contactors. Units on emergency circuits are part of general lighting system.

ment shall conform to requirements noted in succeeding specification clauses.

All branch circuits shall be installed as shown on the plans. Minimum size conductors shall be No. 12, Type —— insulation, 600 volts, except as otherwise noted. Larger size conductors shall be used where noted herein or indicated on the drawings.

Outlets shall be located as shown on the plans. Where located in panelled work or other special interior finish, they shall be properly centered. Boxes shall be of the type noted and approved for the specific application.

Wall switches of specified type and rating shall be installed as shown on the plans and shall control the outlets indicated. They shall be mounted —— ft, —— ins. above floor level unless otherwise noted.

Receptacles shall be of the type and rating specified herein or indicated on the plans. They shall be installed —— ins. above floor level at designated locations, unless otherwise noted on the plans or in the specifications.

Conductors terminating at wired outlets shall extend at least 8 ins. beyond the outlet to facilitate installation of wiring devices or fixtures. All connections shall be made mechanically and electrically secure. Splices shall be soldered, or made with approved wire connectors, and properly insulated for the system voltage.

6.1 Lighting

Depending upon the complexity of the design and installation, lighting system specifications can be all-inclusive or divided into sections relating to specific systems and techniques. In either case, it is important to indicate on the plans the type of branch circuit raceways, conductors, number of circuits, type of fixtures (see Section 7.0) and method of control. Typical specification clauses follow.

6.11 General lighting

Branch circuit conductors for the general lighting system shall be installed in (specify type of raceways) from the panelboards to outlets and between outlets as indicated on the plans.

No wire smaller than No. 12 shall be used for any lighting branch circuit. If the single distance from panelboard to first outlet exceeds 50 ft, the minimum size conductor for this run shall be No. 10. If, in special cases, this distance must be exceeded, larger conductors of sizes noted on the plans shall be installed.

Outlets shall be as specified herein and shall be of a type approved for installation conditions encountered (flush plaster or dry wall, masonry construction, concrete slab, surface mounting boxes or conduit fittings).

This can be expanded, if desired, by adding typical specification clauses covering component parts and accessories noted elsewhere in this section.

6.12 Special circuits

Where the design involves lighting other than general lighting, add clauses to define each type. This might cover, for example, show window lighting, parking areas, private streets and drives, building or area floodlighting. Include description of control features.

Branch circuit wiring for show windows shall be installed as noted on the plans. Circuits shall supply window lights only and shall be separately controlled by (time-switch or manual switches) as indicated.

6.13 Receptacle circuits

Furnish and install branch circuits to receptacle outlets as noted on the plans. Circuits shall be (specify conduit and wire, wireways, multi-outlet assemblies, etc.) as indicated in specific areas.

No wire smaller than No. 12 shall be used for any branch circuit supplying convenience outlets. No receptacles shall be supplied by any circuit (2-wire or 3-wire) that also serves one or more lighting outlets. For excessively long runs (50 ft or more) from panelboard to first receptacle outlet, minimum size wire shall be No. 10 with conductors between outlets being No. 12.

Receptacle circuits shall be (fuse, circuit breaker or switch) controlled as indicated on the plans.

Receptacles for specific areas shall be of the size and type indicated on the plans and specified herein.

This part of the specification can be amplified by including relevant wiring device clauses noted elsewhere.

6.2 Emergency circuits

Emergency lighting systems normally include separate circuits to specified exit signs, specific lighting outlets to permit safe egress from a building or area, or special circuits to keep essential equipment and processes operating during a power outage. Automatic transfer equipment shifts such circuits from normal supply sources to standby power facilities when an emergency condition occurs. These standby facilities must energize the emergency circuits for a specified period of time until normal service can be restored.

Regulations governing emergency systems are covered by municipal, state, federal and other codes. NEC provisions are intended only to apply to the installation, operation and maintenance of such systems.

Frequently, local or state regulations designate the number, location and wattages of lighting outlets; also types and ampere-hour or full-load capacity of auxiliary emergency systems together with minimum voltages. It is good practice to check with local authorities before designing and developing specifications for emergency equipment and wiring layouts.

Specify emergency circuits as a complete system including emergency service or standby power facilities, automatic control features, feeders, panelboards, branch circuits and outlets.

The electrical contractor shall furnish and install a complete emergency lighting system, as shown on the plans, including necessary standby power equipment, control accessories, feeders, panels, branch circuits and outlets as noted.

All wiring shall be (specify conduit and wire or other method) of sizes indicated on the drawings and shall conform to the provisions of the NEC and all other local regulations covering this type of installation.

Supplement this general emergency system specification clause with the necessary relevant clauses covering equipment and accessory items. Some of these items are noted below.

6.21 Independent sources

Two or more separate and complete emergency lighting systems with independent current supply. If the several supply systems also serve all or part of the general lighting system, make this clear in the plans and specifications. Also include automatic transfer equipment necessary to keep emergency lighting circuits energized in case of power failure.

6.22 Standby generators

When automatically (or manually started) standby generator sets are the emergency power source, include definitive specification clauses covering such equipment and its related control. A typical specification appears in Section 2.131 under Service Entrance, auxiliary services.

6.23 Storage battery sets

Auxiliary storage battery systems of approved type may be provided instead of, or in addition to, independent sources for emergency lighting systems. A typical specification for this equipment appears in Section 2.132 under Service Entrances, auxiliary services.

6.24 Warning signals

Approved signal devices of audible or visual type to give warning of derangement of the emergency current sources and to indicate when batteries or generator sets are carrying the emergency electrical load.

6.25 Small battery circuit

Small non-compulsory storage battery system with separate circuit to small number of specially equipped lighting units located in several important areas. Circuit is fed from an automatic battery control panel and has no electrical connection with other normally supplied circuits.

Control panel usually consists of an automatic battery charging device and an automatic switch or relay to turn on auxiliary lighting circuit on normal power source failure. Connection must be provided between auxiliary lighting circuit control panel and normal supply to operate automatic throwover relay or switch and battery charger.

Give details in specifications, and on plans, noting capacity and voltage of battery and nameplate information on automatic throwover switch and battery charger. List equipment number and manufacturer's name, or approved equal.

6.26 Package units

Individual unit equipment emergency lighting system where a complete package unit contains lamps, storage battery, charger and automatic transfer relay. Package units are shelf- or bracket-mounted at strategic locations throughout a building and permanently connected to a nearby 115-volt circuit on normal supply. On normal supply failure, package unit automatically turns on and provides emergency light for a specified time.

Specify number, location and manufacturer's name, or approved equal, of package units to be installed where indicated on plans.

6.27 Main service tie

Connection to supply side of main service, if sufficiently separated electrically and physically from main service disconnect to minimize possibility of simultaneous interruption of supply.

Specify point of connection to main service, size of circuit to emergency lighting transformer and/or lighting panel; also size of disconnecting means and method of control.

6.3 High Frequency Circuits

Separate plans and specifications should be developed for high frequency electrical systems. Since the application of high-cycle current to lighting and power systems is a relatively new development, it might be advisable to include more descriptive detail in the specifications than is normal for the well-known 60-cycle systems. In many cases, equipment and circuit components for high frequency lighting and power systems are sufficiently different from conventional items to warrant this detail. As system installations become more numerous and equipment items become standard catalog items, specification clauses can be tailored accordingly.

The specifications and plans should be all-inclusive, starting with the conventional 60-cycle circuits feeding the frequency converters and proceeding with the converters, high-frequency feeders to the high-frequency distribution panels and on through the branch circuits to the high-frequency lighting fixtures or other equipment. Note specifically the frequency and voltage of the system.

A typical specification for a high-frequency lighting system might read as noted below.

6.31 High frequency lighting

The electrical contractor shall furnish all equipment, materials, accessories and labor to install a complete —— cycle, —— volt lighting system for the —— area as noted on drawing No.——.

From the —— ampere (circuit breaker, fused disconnect) in the —— volt distribution center, run a 3-phase, 60-cycle circuit to each of the —— cycle, —— volt, frequency converters noted on the plans. Each circuit shall consist of three No. ——, Type —— conductors in —— -in. —— conduit.

Install and connect the frequency converters and related control.

From each frequency converter install single-phase, —— cycle, —— volt circuits to the high frequency distribution panels as noted on the plans. Each circuit shall consist of two No. ——, Type —— conductors in —— -in., —— conduit.

Branch circuits from the high-frequency panels to the lighting outlets shall be single-phase, —— cycle, —— volt. Conductors shall be —— No. 12, Type —— installed in —— conduit of size noted on the plans. Each circuit shall serve —— fixtures as indicated. Fixtures shall be located as shown on the plans and shall be installed —— ft, —— ins. above floor level.

6.32 High frequency converters

Rotary converter sets are available as compact package units which are specifically designed to provide power to lighting systems at specific frequency and voltage values. The driving motors are conventional units for operation at conventional secondary voltages. The generators are available to provide power at the desired frequency and voltage, such as 3-phase, 600-volt, 400 cycles, 6-wire (three single-phase circuits), with 300 volts maximum to ground. Typical rotary converter specifications appear in Section 8.0—Motors and Generators. A subsection 8.542 covers equipment.

Static type converters are also available. One such converter is the magnetic frequency multiplier (360 cycle secondary), which has no moving parts, and can be considered as a transformer (transforming both voltage and frequency). Another is a transistorized high frequency power source for lighting. One such unit, for example, delivers up to 1.5 kw at 1500 cycles and 150 volts peak. Manufacturers of static type converters should be contacted for specifications covering latest developments.

6.33 High frequency panelboards

Distribution panelboards for high frequency lighting circuits are usually built to fit a specific installation design. Mains are designed to accommodate one or more single-phase feeders from the frequency converter and branch circuit facilities provide 2- pole, 600-volt disconnect and protective means for a specified number of single-phase, high-frequency branch circuits. A typical high-frequency panelboard specification appears in Section 4.0—Switching and Protection.

6.4 Power circuits

Branch circuits shall be installed from power distribution panels to individual outlets, or control equipment, as indicated on the plans. Conductors shall be of the size and type noted and installed in (specify type of raceway) of size indicated or required by the number of conductors involved.

If numerous types of operating conditions (heat, moisture, dust, etc.) are to be encountered throughout the building, carefully specify cable insulations and raceway enclosures for each area involved; also type of control equipment and enclosures.

6.41 Individual circuits

Each motor shall be supplied by an individual branch circuit from the power distribution center (panelboard) indicated on the plans. Circuit conductors and raceways shall be of the size and type noted on the drawings.

6.42 Subfeeders

Where indicated on the plans, groups of motors shall be supplied by subfeeders from the distribution center. Subfeeders shall be brought direct to motor starters (or disconnect means) or shall terminate in a (cable trough) (bus trough) above the grouped starters with tap conductors connecting individual starters (or disconnect means). Conductors shall be of sizes indicated on the plans and troughs shall be sufficiently large to facilitate tap connections.

6.43 Bus duct taps

Motors shall be supplied by individual taps from the busbar distribution system. Taps or bus plugs shall be provided with (disconnect switch, fuses, circuit breakers, etc., as required). Circuit shall be extended from bus plug to controller in (conduit, flexible conduit, armored cable, heavy duty bus drop cable, etc.) not to exceed 25 ft in length. Circuit shall be installed so that conductors and terminal connections will not be damaged by machine vibration.

The electrical contractor shall furnish and install all motor starters, push-button control stations, disconnect switches, thermal protective devices and fuses. Where motor starters are an integral part of a machine, the electrical contractor shall furnish and install thermal protective devices and fuses for such units.

6.43 Heating circuits

Where separate branch circuits for heating equipment are indicated in the design, specify clearly the number of such circuits originating at a distribution center, the size and type of conductor and raceways to be installed and the number of heating units per circuit. If the heating system is extensive, a separate drawing and specification might be advisable.

6.44 Receptacle circuits

Where receptacle circuits are intended for portable power equipment and devices, a separate specification clause or clauses should be developed to cover these items. Note specifically the phase and voltage of these circuits; number, size and type of conductors; size and type of raceways; location and height of receptacle units.

Size and type of receptacles for specific use are also important. Clearly state whether they are to be single or duplex; standard or locking type; grounded or ungrounded; standard or arc-extinguishing type; 2-wire, 3-wire or 4-wire; standard, weatherproof, dust-tight or explosion-proof enclosures. Use of manufacturer's name and catalog number, or approved equal, establishes equipment quality, facilitates identification, estimating and procurement of specified items.

6.45 High frequency circuits

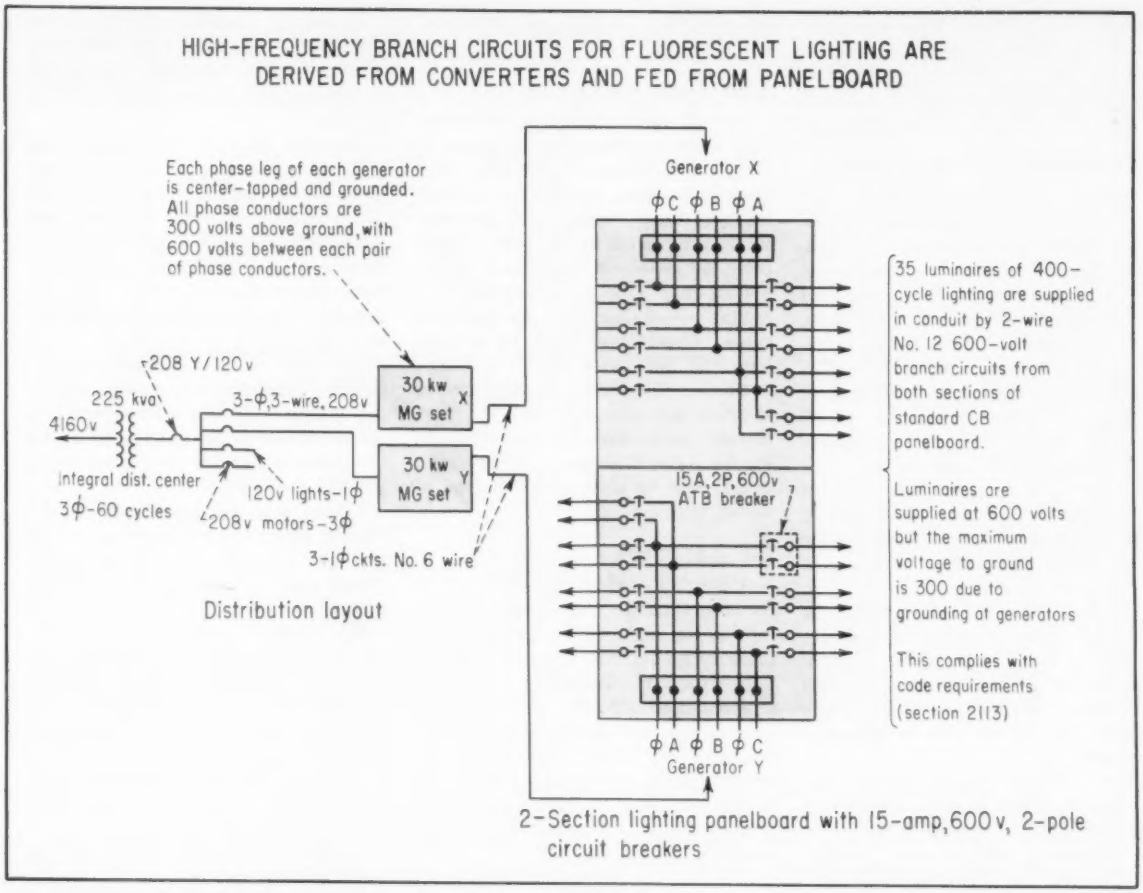
Develop a separate group of specification clauses covering branch circuits serving power equipment operated at high frequency (above 60 cycles). These may be added to the overall specification for the high frequency system.

Clearly indicate the size and type of conductors (conventional wire, concentric conductors, coaxial cables) to be installed and the type of raceways (metallic, non-magnetic) to be used. Check manufacturers' and engineering research findings and recommendations in this respect.

Where standard 60-cycle control equipment is to be used on high-frequency circuits, note any derating factors which must be applied because of the frequency and current values involved. Incorporate any such recommendations in the specifications.

6.5 Conductors

A number of different types of conductors may be indicated in a single electrical system design. Known or anticipated operating conditions and procedures, atmospheric conditions, ambient temperatures, moisture conditions, structural and installation conditions all influence choice of conductor type. Reflect such choice in the specifications by stating definitely what



HIGH FREQUENCY LIGHTING SYSTEM is explained in single drawing showing normal energy source, frequency converters, special distribution panel and branch circuit connections.

type of conductor is to be installed in specific areas of the building or parts of the electrical system.

6.51 Conductors in raceways

All conductors for low voltage (under 600 volts) branch circuits in raceways shall be of the AWG sizes noted and insulated for 600 volts. Except as otherwise noted, wire sizes No. 10 and smaller shall be solid, single braid; No. 8 and larger, stranded, double braid.

All conductors shall conform to the latest requirements of the National Electrical Code and meet all ASTM specifications. Conductors shall be thoroughly tinned, soft drawn copper (or aluminum). Wire size, insulation type, and manufacturer's name shall be permanently marked on the conductor jacket at regular intervals. All wire shall be delivered to the job in complete coils containing manufacturer's name with an approval tag indicating wire size and type of insulation. Wire shall be color-coded with a separate color for each phase and neutral used consistently throughout the installation.

Wire and cable shall be as manufactured by (name one or more companies) or approved equal.

In general, conductors with the following types of insulation shall be installed where indicated on the plans and noted below:

- **a. Type R (RH, RU, RUH, T, etc.) in raceways above grade in permanent dry locations.**
- **b. Type RW (RUW, RHW, TW, etc.) in raceways exposed to moisture or in concrete slabs on fill or below grade.**
- **c. Type AVA (AVB) in raceways exposed to extremely high ambient temperatures.**

6.52 Armored cable

For all armored cable wiring as called for elsewhere in these specifications or shown on plans, furnish and install approved armored cable properly bushed at ends and securely fastened to outlet boxes with approved connectors. Armored cable shall be of the best quality designed to offer a low resistance grounding path. Wires entering outlet boxes shall be not less than 8 ins. long before stripping for joints or connections to devices. Armored cable shall be as manufactured by ——, or approved equal.

6.53 Non-metallic sheath

For all non-metallic sheath cable branch circuits as called for elsewhere in these specifications and noted on the plans, furnish and install the indicated sizes of non-metallic sheath cable of the —— type, with —— insulation, as manufactured by the —— Company, or approved equal. The cable shall be approved for the type of service and installation conditions noted. Cable shall be supported every 4½ ft by —— type straps or staples approved for the purpose.

Where cable is to be installed in wet or corrosive atmosphere, cable shall be Type NMC (moisture and corrosion resistant).

Where branch circuit cable is shown underground (direct burial), cable

shall be Type UF with Type RW, TW, RUW, or RHW insulated conductors and overall outer covering which shall be flame-retardant, moisture-resistant, fungus-resistant and corrosive-resistant.

6.54 Mineral-insulated cable

Branch circuit conductors in the —— areas, where indicated on the plans, shall be of the mineral-insulated, metal-sheathed type as manufactured by the —— Company, or approved equal. Cable shall be (one, two, three, etc.) conductor with a highly compressed refractory mineral insulation (magnesium oxide) encased in a continuous metal (copper) sheath. Cable shall be installed in strict accordance with manufacturer's instructions.

Cable shall be supported, at not more than 6-ft intervals, by means of approved staples, straps, hangers, or other fittings, to building structure or specially designed brackets.

At termination points, cable shall be provided with an approved seal immediately after stripping to prevent entrance of moisture into the mineral insulation. Conductors beyond the sheath shall be encased in approved insulating sleeve.

When MI cable is connected to outlet boxes, panels, or other equipment, approved fittings suitable for the service conditions shall be used. Fittings shall be of the threaded-gland type with "screw-on pot" seals filled with an insulating compound approved for the atmospheric and service conditions in which the cable is used. Fittings shall be as manufactured by the —— Company, or approved equal, and shall bear an Underwriters' label of approval.

Stripping of cable ends, installation of fittings, application of insulating compound, and actual cable terminations shall be made according to manufacturer's specific instructions.

Mineral-insulated cable has conductors of high conductivity copper meeting ASTM specifications B4 or B5. The conductors and finely divided, highly compressed, magnesium oxide powder insulation are encased in a continuous seamless copper tubing. Cable has a 600-volt rating with a maximum continuous working temperature of 250°C. (482°F.). Current-carrying capacity is listed as being limited only by the safe operating temperature of the sheath, terminating arrangements and voltage drop.

Where MI cable is installed in hazardous locations, it is recommended that local inspection authorities be consulted to be certain that the proper terminal fittings and insulating compound approved for existing use conditions are installed.

6.55 Open wiring

For all open wiring or knob-and-tube work as called for elsewhere in these specifications, furnish and install non-combustible, non-absorptive insulating bushings, cleats, knobs and tubes as manufactured by the —— Company, or approved equal, and flexible non-metallic tubing as manufactured by the —— Company, or approved equal. Conductors shall be of size indicated and shall have —— type insulation. They shall be supported at intervals not exceeding 4½ ft. Non-metallic outlet boxes as manufactured by the —— Company, or approved equal, may be used with this type of wiring system.

6.6 Raceways

A number of raceways are available for branch circuit conductors. Factors influencing selection of specific types of raceways include: type of construction; structural conditions; space limitations; installation ease and economy; atmospheric and operating conditions; degree of flexibility offered by the branch circuit distribution design. So it is not unusual to have a variety of raceway systems indicated in a single electrical system design.

Specifications should clearly indicate the types of raceways to be furnished and where each is to be installed. Typical specification clauses covering a number of these systems follow.

6.61 Conduit

For all conduit installations specified herein, or noted on the plans, furnish and install (select one or more types and state where each type shall be used):

a. Corrosion resistant rigid steel conduit

b. Aluminum conduit

c. Corrosion resistant, non-ferrous alloy rigid conduit

d. Flexible metallic conduit

e. Plastic-coated metallic conduit

Conduit shall be of sizes noted on the plans, or required by the NEC for the number and sizes of conductors indicated. Except as noted otherwise, minimum size conduit shall be ¾-in. trade designation.

All conduit joints shall be cut square, threaded, reamed smooth and drawn up tight. Bends or offsets shall be made with standard conduit ells, field bends made with an approved bender or hickey, or hub-type conduit fittings. Number of bends per run shall conform to NEC limitations.

Concealed conduits shall be run in a direct line with long sweep bends and offsets. Exposed conduits shall be run parallel to and at right angles to building lines.

Conduits shall be continuous from outlet to outlet, from outlets to cabinets, pull or junction boxes and shall be secured to all boxes with locknuts and bushings in such manner that each system shall be electrically continuous throughout. Conduit ends shall be capped to prevent entrance of foreign materials during construction.

All exposed conduit runs shall be installed without moisture traps. Where this is impracticable, a hole drilled in the underside of the conduit or a pull box installed at the low point shall provide drainage.

Where field conditions require indicated concealed conduits to be run exposed, approval of authorized personnel must be secured before installation.

All conduit systems must be installed complete before conductors are pulled in. Conduits shall be securely supported at —— ft intervals by —— straps, or —— hangers, or supporting assemblies as indicated on the plans.

Conduit, elbows and couplings shall be as manufactured by the —— Company, or approved equal.

Conduit fittings, as indicated on the plans, shall be as manufactured by the —— Company, or approved equal.

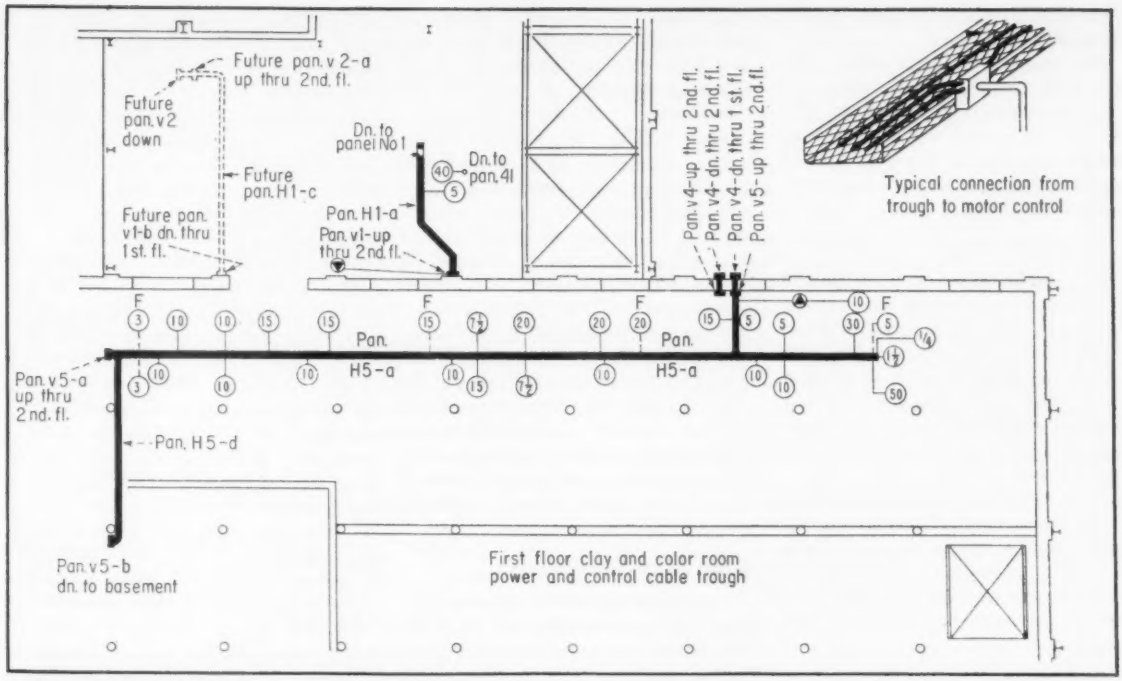
6.62 EMT

Electrical metallic tubing raceways as called for in the specifications and shown on the plans shall be approved type as manufactured by —— Company, or approved equal. Couplings and connectors shall be of the threadless type as manufactured by the —— Company, or approved equal. All connectors shall be made up tight. If tubing is installed in wet locations, or buried in masonry, concrete, or fill, couplings and connectors shall be of a watertight type.

6.63 Wireways and troughs

Furnish and install wireways, complete with necessary fittings, to house branch circuit conductors as noted on the plans and called for elsewhere in these specifications. The cross-sectional dimensions of the wireways shall be —— in. by —— in. Covers and knockouts shall be provided according to manufacturer's details. Wireways and fittings shall be as manufactured by the —— Company, or approved equal.

Wireways shall be securely supported by approved methods at 5-ft



CABLE TROUGH LAYOUT for routing and supporting branch circuit cables to group of motors. Detail shows method of making taps at trough.

intervals. Number of conductors per wireway shall conform to the latest edition of the National Electrical Code.

Where indicated on plans, and specified herein, branch circuit cables shall be installed in cable troughs (trays) of expanded metal (steel, aluminum) or other approved construction. Troughs (trays) and complete complement of fittings, offsets, and individual circuit outlets, shall be as manufactured by the —— Company, or approved equal. Trough (tray) system shall be securely mounted to or suspended from the building structure.

Maximum size and number of approved conductors installed in the trough system shall conform to limitations established by the current edition of the National Electrical Code.

6.64 Surface raceways

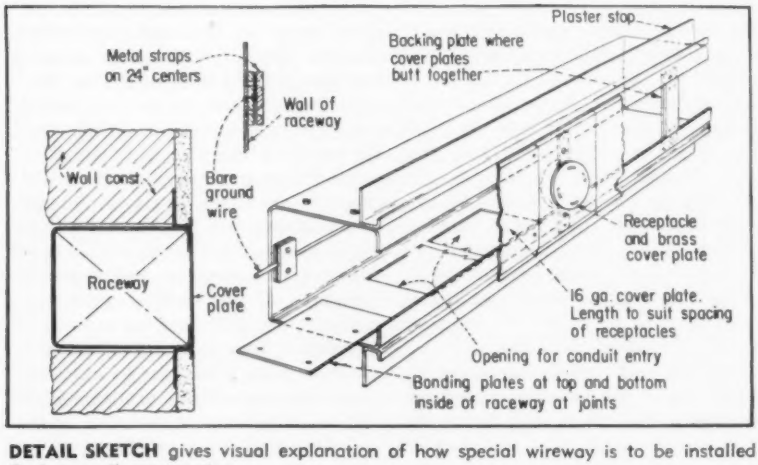
The bold face type below covers typical specification clauses for a number of conventional surface raceways systems.

A. Surface type

Furnish and install where indicated on plans surface metal raceways as made by the —— Company, or approved equal. Raceway, elbows, fittings and outlets shall be of the same manufacture and designed for use together. They shall be of a size as noted, approved for the number and size of wires indicated, and shall be installed in an approved and workmanlike manner. Runs shall be parallel or at right angles to walls and partitions. Connections shall be made to other types of raceways in an approved manner with fittings manufactured for the purpose and application.

Where combination metal raceways are installed for signal, lighting and power circuits, each system shall be run in separate compartments identified by sharply contrasting colors on interior finish. Compartments shall maintain same relative position throughout the system.

The number of conductors installed in any raceway shall not be greater than the number for which the raceway is approved.



DETAIL SKETCH gives visual explanation of how special wireway is to be installed flush in wall construction.

B. Baseboard type

Furnish and install, as indicated on the wiring plans, a system of metallic baseboard wireways for (indicate whether single raceway for 115-volt service, single raceway for telephone and signalling service, or two parallel raceways or combination raceway for two complete systems, one for 115-volt

service and one for telephone and signalling services.)

This system shall be installed complete with junction boxes, outlet fittings, cross-connected raceways, circuit conductors and wiring devices as indicated on plans. The system shall be as manufactured by —— Company, or approved equal.

C. Multi-outlet type

At locations shown on plans furnish and install a multi-outlet assembly in one or more continuous sections. These sections shall consist of a raceway with outlets to receive standard attachment plugs spaced —— in. apart. Raceway and associated outlets shall be as manufactured by —— Company, or approved equal.

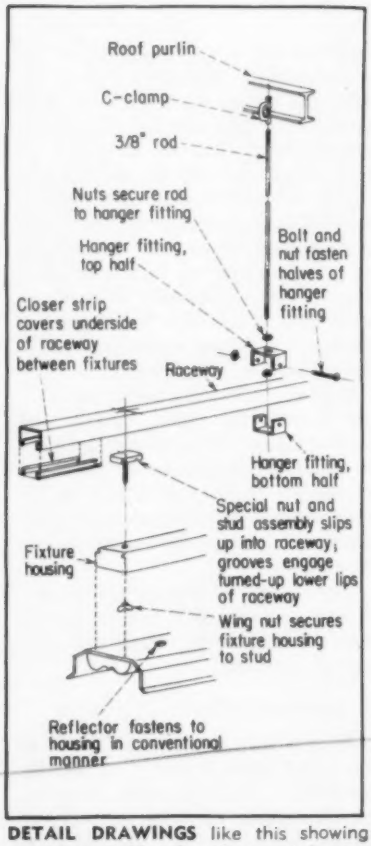
For window and cove lighting reflectors furnish and install metal raceway or wireway assemblies containing lamp receptacles connected on circuits as indicated on wiring plans. They shall be as manufactured by —— Company, or approved equal.

D. Metal framing

Continuous slot steel channel framing, frequently used to provide support for electric lighting fixtures may also be used as a raceway for branch circuit conductors if approved for the purpose and equipped with a closure strip.

This cold-rolled steel channel with a continuous slot comes in a square and rectangular cross section; has a nut and bolt assembly which can be inserted and tightened anywhere along the length of the slot to eliminate punching and drilling bolt holes.

When specifying this type of raceway and support system indicate manufacturer's name and catalog designation, or approved equal, to establish size and strength of channel desired. Also indicate spacing of supporting hangers or brackets, and the need of closure strip if the channel is used as a raceway.



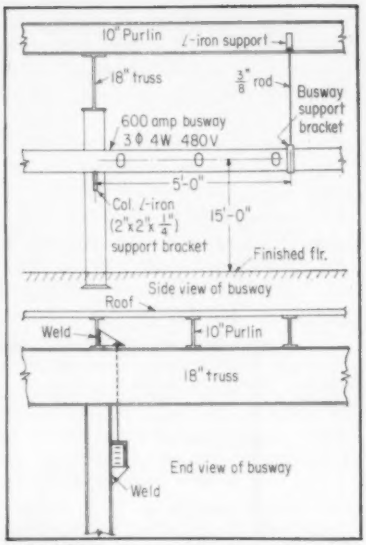
DETAIL DRAWINGS like this showing typical assembly of surface metal raceway serving as conductor enclosure and fixture support simplifies estimating and field installation.

6.65 Plug-in busways

Furnish and install a complete prefabricated plug-in type bus duct distribution system as shown on the plans. Busway shall be —— volt, —— phase, ——pole, of the ampere capacities as indicated (specify the ampere size of bus duct for various sections of the branch circuit distribution system). Each 10-ft section of duct shall have (specify number) covered openings for attachment of plug-in type current take-off devices. The system shall be complete with all fittings, enclosures, insulating and supporting members as shown; shall be supported from the building structure at 5-ft intervals. System and parts shall be of the same manufacture and designed to be used together. Assembly and installation shall be made according to the manufacturer's recommendations. The bus duct shall be Type —— as made by —— Company, or approved equal.

Installation should be detailed on the plans and all bus capacities, taps and fittings noted. Specifications may include gauge of metal, dimensions of copper (or aluminum) bars, type of insulation, facilities for tap connections and methods of attachment to building structure. Unless the bus duct system is made up of standard lengths and fittings, a manufacturer's detailed dimensional drawing for the complete system should be secured and approved before the equipment is installed. It is not advisable to cut duct sections to fit structural requirements at field locations.

Furnish and install bus plugs as listed and at the locations shown on the plans. Bus plugs shall be of the type and size designated and shall be of the same manufacture as the bus duct and designed for use with it. (Specify disconnect, overcurrent protection, capacity and type of raceway or cable connection required.)



METHODS of supporting bus duct distribution circuits from building structural steel is visualized by these side and end view drawings.

Connections from the plug-in device to the equipment served shall be made with —— (specify wire and conduit; flexible metallic conduit; or heavy-duty, multi-conductor, bus drop cable). Terminations at motor control cabinets shall be so made that machine vibration will not loosen the mechanical and electrical connections.

Where indicated on the plans, and noted in the specifications, furnish and install capacitor plugs (state kva rating), transformer plugs (state kva rating), ground detector plugs, temperature indicating plugs, transposition sections, and expansion joints.

6.66 Trolley type busway

Furnish and install a complete busway system, as indicated and detailed on the plans, for operation of each mobile current-collecting device. Busway shall be —— ampere, —— phase, —— pole, —— volts. System shall be complete with necessary straight or curved busway sections, drop-out sections (if necessary) for insertion and removal of trolley-type current collecting devices, cable feed-in facilities, end closures and bumpers, and approved hangers. All parts shall be of the same manufacture and designed to be used together. Assembly and installation shall be made according to manufacturer's recommendations. System shall be —— type as manufactured by the ——Company, or approved equal.

Furnish and install a total of (state

number) current-collecting trolleys. Trolleys shall be —— ampere, —— phase, (fused or unfused), with (sliding disc, brush, or roller) contacts and equipped (with or without tool hangers). Units shall be designed for use with the busway and provide continuous electrical contact as they move freely along the entire length of the busway.

Furnish and install a single-phase, trolley-type busway system to provide branch circuit wiring for lighting fixtures as indicated on the plans and noted elsewhere in these specifications. Busway shall be —— ampere, —— pole, —— volts, and shall provide continuous electrical contact for mobile, or stationary type (twist-type) current-collecting devices as noted. System shall be complete with necessary fittings, couplings, feed-in devices and current take-off units. Duct runs shall be (flush, messenger cable, rod hanger) mounted and supported by approved hanger fittings at 5-ft intervals, unless closer spacing is indicated on the plans or noted in the specifications.

All fixtures shall be electrically fed and mechanically suspended from the busway with approved supports so that suspension is independent of current tap-off device.

Furnish and install a total of (number) current-tap units of the (twist-type or trolley) type as noted on the plans and listed in these specifications. Current take-off units shall be of the (terminal or receptacle) type as noted. Busway, tap-off units and accessories shall be Type —— as manufactured by the —— Company, or approved equal.

Where noted on plans, furnish and install a complete messenger cable system to support the busways. Exact location of messenger cable runs shall be determined in the field. Cable shall be ⅜-in. diameter, high strength, —— strand, galvanized steel wire. Where messenger bridles are used, they shall be of ⅝-in. diameter galvanized flexible steel wire. Cables shall be securely anchored to building steel with end-brackets as detailed on the drawings. Intermediate supports from roof steel structure, and wherever necessary, shall be made of ⅜-in. diameter bolt rod supported by beam clamps. Maximum cable sag allowable is 1-in. with busway and fixtures in place. Messenger cable installation shall include all clamps, bolts, devices, turnbuckles, supports, and anchors necessary to provide a secure system.

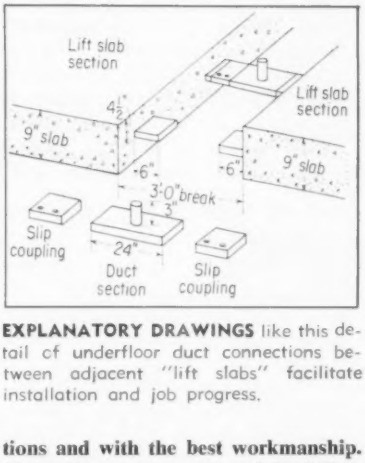
Mobile busway systems should be detailed on the plans with full and accurate dimensional information. Methods of supporting the system and circuiting to the various busway sections should be indicated clearly.

6.67 Underfloor duct

Furnish and install a complete (metal) (fiber) underfloor duct system as shown on the plans. System shall consist of (number) ducts, of size as indicated, to provide raceways for (110-volt) (telephone) (low tension) system wiring. All duct, fittings, junction boxes, outlets, connectors, and supporting brackets shall be as manufactured by the —— Company, or approved equal and designed for use with this system.

Connections between the duct system and distribution cabinets and wall outlets shall be made with rigid or flexible steel conduit, or fittings specially approved for this purpose.

Duct, junction boxes, outlets, and connections shall be installed according to manufacturer's recommendations and with the best workmanship. All surface covers, where intended to be flush with the finished floor, shall be level and true. All inserts shall be sealed against entrance of moisture. Dead ends of all ducts shall be closed and sealed.



EXPLANATORY DRAWINGS like this detail of underfloor duct connections between adjacent "lift slabs" facilitate installation and job progress.

Unless otherwise indicated, all outlets for all systems shall be installed and wired complete.

Suitable markers shall be installed at the end of every line of raceway to mark the line of the duct. Suitable markers shall be installed to act as base points for locating duct outlets for future use.

6.68 Cellular floors

A. Steel floors

Building construction in the areas shown consists of cellular steel floor of a type approved for use as raceways for electrical conductors.

In these areas, wiring distribution for the 110-volt branch circuits, branch telephone circuits, and low tension (any other) systems, shall be installed in the floor cells, as noted on the plans.

Furnish and install all header ducts (floor or ceiling type), end closures, feed connections, floor covering adapters, outlets and taps as listed and shown on the plans. All duct and devices shall be as approved by the Underwriters' Laboratories for use with cellular steel floor system and shall be as manufactured by the —— Company, or approved equal.

Cover plates, furnished by others, shall be brushed with cold flowing compound and attached to the floor by self tapping screws.

All junction units shall be adjusted to screed line and leveled before concrete pour. Floor covering adapters must be of a size to conform to the thickness of floor covering to be used.

End closures shall be sealed as recommended by the manufacturers.

All fittings and outlets shall be designed for the type of floor used and be installed in an approved manner according to instructions supplied by the manufacturer.

The cellular steel floor shall be grounded at a suitable location in accordance with local regulations.

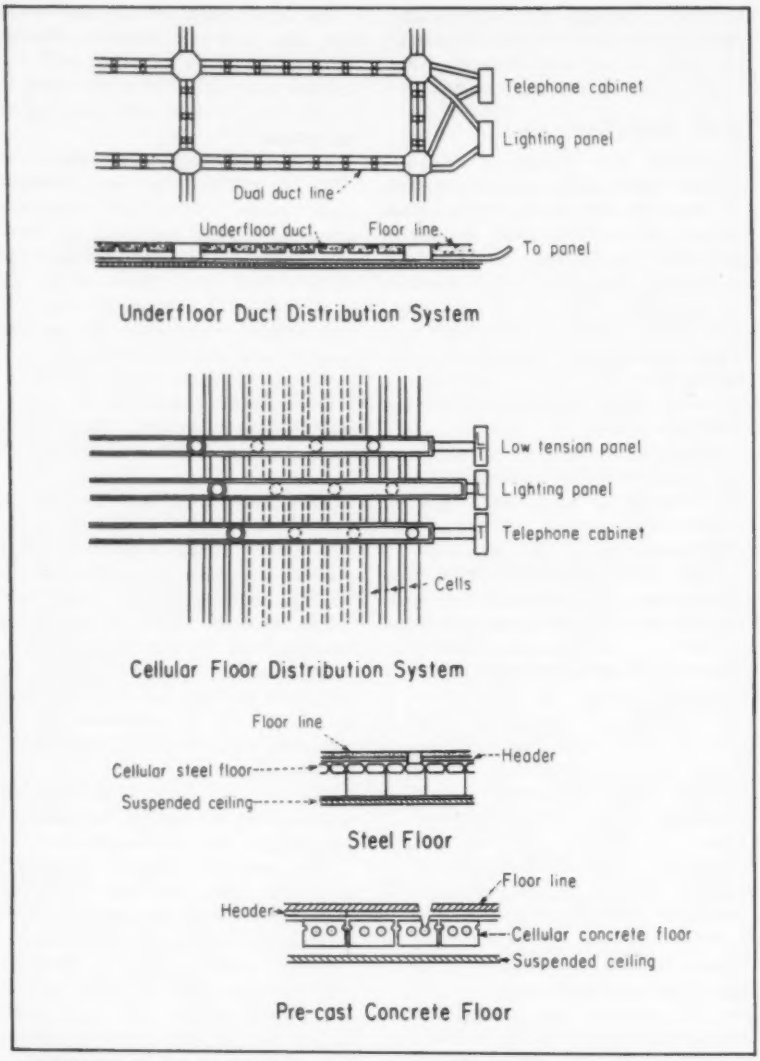
The headers, outlets, extensions from cells, etc., shall be roughed-in as a system and all wire shall be pulled after fill and finish are completed.

Install suitable markers, identifying particular cells of each system, on top of selected cells and finish flush at screed line. Extend marker through floor covering with a grommeted screw. There shall be one marker per system for every 200 sq ft of floor area, and not less than two per system per room, as directed.

A total of —— floor taps and 110-volt (specify type) outlets shall be cut in where directed upon occupancy. These shall be wired complete, with a maximum of —— outlets per circuit. Furnish —— outlets, complete with taps, as spares.

A total of —— floor taps and (specify type) low-tension floor outlets shall be cut in where directed upon occupancy. Furnish —— outlets, complete with taps, as spares.

Electrical manufacturers produce header ducts and outlet fittings and accessories for specific types of cellular steel floor systems. It is important that the header ducts and fittings specified are designed for installation with the type of cellular floor used in the building.



UNUSUAL BRANCH CIRCUIT flexibility is provided by these underfloor distribution techniques: underfloor duct, cellular steel and cellular concrete floor construction.

B. Concrete floors.

Building construction in the areas shown on Drawings No. —— consists of pre-cast cellular concrete slabs of a type whose cells are approved for use as electrical raceways. Branch circuit wiring for (110-volt, telephone, signal and other low tension systems) shall be installed in the concrete cells as noted on the plans.

The electrical contractor shall furnish and install all transverse metal header ducts, panel collars, riser ducts, wall elbows, feeder duct ground strips, leveling bolts, drive plugs for outlet extensions, knockout markers and necessary outlet fittings to make a complete branch circuit distribution system.

All header duct components and outlet accessories shall be approved by Underwriters' Laboratories for use with cellular concrete floor construction and shall be as manufactured by the —— Company, or approved equal. Installation shall be in accordance with NEC regulations and manufacturer's recommendations.

Cell inserts shall be of metal and levelled to floor grade and sealed against entrance of moisture. Receptacles shall be of the grounded type and a ground conductor shall connect receptacles to a positive ground connection provided on the header duct. All header duct joints and end closures shall be effectively sealed against entrance of moisture. Duct and cells shall be kept free of debris and foreign materials.

Expand the above clauses to include designation of what cells are to be used as conductor raceways, the number and spacing of inserts, receptacles and outlets to be installed at present, and the number of each type of outlet fittings to be supplied for future installation; the location and installation of suitable markers. Follow pattern of cellular steel floor specification.

6.7 Hazardous Locations

When designing and specifying electrical systems for hazardous locations, carefully check the class of hazard against the equipment listing. Secure the owner's written statement as to the type of operation to be carried on within the area, and check the design and proposed layout with inspection authorities having jurisdiction. After determining definite degree of hazard, specify equipment according to NEC classifications.

All equipment, fittings and wiring installed in the —— area, as noted on the plans, shall be as approved by the National Electrical Code for Class ——, Division —— locations. Materials shall be of the best quality designed for the type of hazard indicated.

At least five full threads shall be engaged on all conduit connections to couplings and fitting hubs. Threads shall be coated with a sealing compound to make connection gas tight. Sealing fittings shall be properly installed at all required locations in accordance with code regulations.

Installation and workmanship shall be of the best quality performed by experienced mechanics to assure maximum operating safety.

Fittings shall be Type —— manufactured by the —— Company, or approved equal.

Switches and controls, of sizes noted on the plans and specified herein, shall be as manufactured by the —— Company, or approved equal.

Lighting fixtures, as noted on the plans or listed in the fixture schedule, shall be of the type indicated and as manufactured by the ———— Company, or approved equal.

The above specification clauses can be expanded, as desired, to fit the specific installation design. If necessary, more detailed information can be given for equipment items.

6.8 Raceway Accessories

6.81 Conduit fittings

Where indicated on the plans, and noted in the specifications, outlets on exposed conduit systems shall be of the threaded-hub, cast metal, conduit type fitting suitable for the wiring devices to be installed. Fittings shall be

Type —— as manufactured by the —— Company, or approved equal.

6.82 Outlet boxes

All outlet boxes shall be of galvanized steel, at least 1½-ins. deep and of sufficient size to accommodate devices noted. Boxes for fixtures shall have fixture studs in the center. All boxes shall have mounting lugs or ears for covers. Boxes shall have knockouts for conduit terminations and approved clamps where armored cable is used.

Standard deep type outlet boxes (concrete rings with appropriate covers) shall be used in floor slab construction so concealed conduits entering sides of boxes can clear steel reinforcing rods.

Outlet boxes for wiring devices in finished walls shall be one-piece standard gang type of size to accommodate number of devices noted. Boxes shall have plaster covers to bring box openings flush with finished wall or not more than ¼-in. back of same.

Bracket outlets shall be located —— ft, —— ins. above finished floor level, and centered on columns or above doors when installed in these locations.

Wall switch outlets shall be set —— ft, —— ins. above finished floor. When located near doors they shall be at a height of —— ft, —— ins. and installed on the lock side of the door.

Clock outlet boxes over doors shall be installed at a height which will center the clock between top of door trim and ceiling. When such outlets occur on blank wails, they shall be installed —— ft, —— ins. above the floor, or a height to meet architectural conditions.

Outlet boxes for concealed telephone and signaling systems shall be of the 4-in. square type with plaster cover and bushed-opening (⅜-in.) cover plate. Telephone wall outlet boxes shall be set flush —— ins. above floor level, unless otherwise noted. Signal system outlets shall be set flush in the wall —— ins. above the floor level, or near ceiling as indicated on the plans.

Boxes for floor outlets shall be of the cast-metal, threaded conduit-entrance, waterproof type with means for adjusting cover plate to finished floor level. Boxes shall be approximately 4 ins. in diameter and 3½ ins. deep, with an approved gasket or seal between adjusting ring and box.

Cover plates on floor boxes shall be of heavy brass with permanent ring or flange and rubber gasket. Plates shall have —— in. diameter threaded hole in center for installation of a flat plug or fitting for receptacle or other type of outlet as indicated by symbol on plans.

Outlet boxes shall be as manufactured by the —— Company, or approved equal.

Watertight floor boxes shall be as manufactured by the —— Company, or approved equal.

6.83 Junction or pull boxes

Junction or pull boxes not over 100 cu. ins. in size shall be standard outlet boxes. Junction or pull boxes over 150 cu. ins. in size shall be constructed same as cabinets with covers of same gauge metal as boxes and secured by screws or bolts. All boxes shall be coated inside and out to prevent corrosion.

Junction boxes in main service conduits shall be ample size. All other junction boxes shall be not less than 4 ins. square by 1½ ins. deep. Removable covers must be accessible at all times. Boxes on concealed conduits shall be set with covers flush with finished plaster line, unless otherwise noted on the plans. Junction and pull boxes of appropriate dimenisons for conduits and conductors noted shall be installed where shown on drawings, and where necessary to facilitate conductor installation.

6.9 Wiring and Control Devices

Specify wiring and control devices according to manufacturer's catalog number to establish quality standard. Note pertinent electrical ratings of each.

6.91 Receptacles

a. Standard duplex receptacles shall be (manufacturer's name) No. ——, or approved equal, rated —— amp, —— volts with T slots in a rugged plastic housing and side wiring binding screws to take up to No. 10 wiring.

b. Split-circuit duplex receptacles shall be (manufacturer's name) No. ——, or approved equal, with the (top, bottom) half of each receptacle arranged for switch control while the other remains energized at all times. Rating shall be —— amp, —— volts.

c. Triplex receptacles with parallel slots shall be (manufacturer's name) No. ——, or approved equal, rated at —— amp, —— volts and equipped with side-wired terminals.

d. Duplex grounding type receptacles shall be (manufacturer's name), No. ——, or approved equal, rated at —— amps, —— volts. Receptacles shall accommodate either standard 2-wire plug or 3-wire grounding type plug.

e. Combination 125- and 250-volt duplex receptacles shall be manufacturer's name) No. ——, rated at —— amps, —— volts. Slot configuration of the high voltage side shall differ from the low voltage side so attachment plugs cannot be interchanged.

f. Fan hanger receptacles, where indicated on the plans, shall be installed —— ft, —— ins. above floor level. Receptacle shall be (manufacturer's name) No. ——, or approved equal.

g. Clock receptacles shall be (manufacturer's name) No, ——, or approved equal, rated at —— amps, —— volts.

h. Where indicated by symbol on the plans, receptacles shall be of the locking type wherein the matching connector cap cannot be pulled from the receptacle until the locking feature is disengaged. Receptacles shall be rated —— amps, —— volts and shall be (manufacturer's name) No. ——, or approved equal.

i. Special purpose receptacles shall be of the capacity (amps, volts) and design (2- or 3-wire, grounded, ungrounded, polarized, etc.) as indicated on the plans. Receptacles shall be (manufacturer's name) No. ——, or approved equal, designed to receive connector caps of appropriate rating and polarity only.

j. Combination receptacle, switch and/or pilot light devices shall be (manufacturer's name) No. ——, or approved equal, with (2-wire, 3-wire grounded) outlet rated —— amps, —— volts and switch rated —— amps, —— volts.

6.92 Switches

a. Wall switches shall be flush tumbler type "T" rated at —— amps, —— volts, unless otherwise noted. Switch mechanism shall be completely enclosed in a stable composition or ceramic housing with binding screws designed to take up to No. 10 solid wire connection. Switches shall be (manufacturer's name) No. ——, or approved equal.

b. Switches indicated by appropriate symbol shall be lock-type, key-operated, rated —— amps, —— volts and shall be (manufacturer's name) No. ——, or approved equal. Furnish —— spare keys.

c. Mercury switches for silent operation shall be (manufacturer's name) No. ——, or approved equal, flush tumbler type rated —— amps, —— volts.

d. Silent operating toggle switches of standard mechanical type shall be (manufacturer's name) No. ——, or

approved equal, rated —— amps, —— volts.

e. Where indicated on the plans, flush toggle switches for control of 2-speed air conditioning, fan or blower motors shall be the maintained-contact, 3-position, 2-circuit type rated —— amps, —— volts, single or double pole as noted. Switches shall be (manufacturer's name), No. ——, or approved equal.

f. Switches controlling or disconnecting motor loads in excess of ⅓ hp shall be horsepower rated and approved for motor control service. Switches shall be (manufacturer's name), No. ——, complete with overload device of proper rating.

Switches shall be single-pole, double-pole, 3-way or 4-way as indicated by the drawing symbols. Where tumbler switches operate vertically switch shall be "on" in the upper position; where operated horizontally, "on" position shall be at left. Where more than one switch is shown at an outlet, switches shall be installed under a gang plate in an order appropriate to outlet location.

Where switches are to be other than toggle type, such as push (tap operated), rotary, rocker-arm, weatherproof lever-operated, etc., specify same by one or more manufacturer's catalog numbers to establish type and quality.

6.93 Time switches

Where specific lighting circuits are to be controlled by time switches, note specific type of switch dial required and specify switch by one or more manufacturer's catalog numbers, or approved equal, to establish quality.

6.94 Central control

Where specific circuits or lighting areas are to be controlled from a single point, specify the size and type of magnetic contactors to be installed. Indicate number of poles, ampere and voltage rating of contactors and if they are to be individually mounted or grouped in a cabinet. Control points and circuits involved should be clearly indicated on the plans.

6.95 Low voltage control

Low voltage relay switching provides switching control similar in operation to the remote control of motors on industrial machines. Circuit switching is performed by relays whose coils are operated by momentary contact switches connected to a low voltage supply. Paragraphs marked "a" are for sequence systems, paragraphs "b", "c", "d" or "e" for positioning systems.

Outlets and circuits indicated by the appropriate symbol on the plans are controlled by a remote control low voltage relay system.

Relays

Furnish at each outlet indicated a relay installed in a box knockout and connected in an approved manner.

Furnish and install at each location where indicated a remote control relay cabinet complete with the number of relays shown. The relays shall be installed in barriers which effectively isolate the circuit conductors from the low voltage control wiring.

Switches

Switches indicated by the appropriate symbol are low voltage remote control type.

Furnish and install at each switch outlet one or more, as indicated, momentary contact low-voltage switches of an approved type designed specifically for low voltage remote control switching service and for the system employed.

a. Switches shall be 2-wire, single pole, normally open, to operate sequence "on-off" relays.

b. Switches shall be 3-wire, single-pole, two-position, normally-open.

Master switch

a. At master switch location furnish and install a multiple switch assembly for master switch service. Each switch shall operate the outlet or circuits indicated and shall be wired to parallel the local switch. Pilot lights associated with each button shall indicate when the relay is in "on" position.

b. At master switch locations shown, furnish and install a combination switch and selector. Manual rotation of the selector shall connect the switch to operate each of the outlets or circuits controlled. The appropriate selector terminals shall be wired to parallel the local switches.

c. At master switch locations shown, furnish and install a multiple switch assembly with master control. Each of the "individual" switches shall operate independently of the others except that operation of the master control will position all of the associated relays in the on or off position simultaneously.

d. Switches shown as master switches shall operate a remotely controlled, electrically operated master unit. When pressed in the "on" position, the unit shall momentarily close all "on" contacts of the circuits controlled. In the "off" position, the unit shall momentarily close all "off" contacts.

e. Switches shown as master switches shall operate a remotely controlled, electrically operated master selector switch. When pressed in the "on" position, the selector shall sweep the "on" contacts of the outlets and circuits controlled. In the "off" position, the switch shall cause the selector to sweep the "off" contacts.

Pilot lights

Furnish and install, where shown, low voltage pilot lights of a type specifically designed to operate with the low voltage, remote control system.

Power supply

Low voltage power for relay operation shall be provided from separate transformers specially designed for the service and for the system installed or from an individual low-voltage source incorporated in the relay device. Transformer characteristics and installation shall conform with the requirements of Article 725—Remote Control, Low Energy Power and Signal Circuits, National Electrical Code.

a. (DC operation) The power supply for relay operation shall include converters or rectifiers to provide dc operating current to the relays. Rectifiers shall be of a type specially designed for the service and the system and shall be enclosed within the relay cabinet.

The low voltage remote control system components and accessories shall be as manufactured by the —— Company, or approved equal.

Conduit, raceways, junction and outlet boxes for the low voltage control circuits shall conform with the specifications for Signal and Communications System.

Conductors and cables shall be of the size and type designed for the system or recommended by the manufacturer. Multi-conductor cables shall contain identified conductors, and circuits shall be wired to maintain a consistent and uniform identification scheme.

6.96 Plates

Furnish and install wall plates of appropriate type and size for all wiring and control devices, signal and telephone outlets. Plates shall be (composition, steel, brass, etc.) of —— thickness. (Add color, finish and special markings as required.)

When devices are installed in exposed conduit fittings or outlet boxes, the plates or covers shall be of a type designed for the fittings or boxes.

7.0 Lighting

- ☐ **Circuit Characteristics**
  - — voltage
  - — phase
  - — frequency
  - — multiple
  - — series
- ☐ **Fixtures To Be Furnished**
  - — by others
  - — by electrical contractor
- ☐ **Optional Equipment** — procedure for submitting alternates
- ☐ **Drawings**
  - — general layout
  - — details of special fixtures
  - — details of special mounting
  - — details of special arrangement
- ☐ **Fixture Schedule**
  - — master for whole project
  - — individual for each area and each plan sheet
- ☐ **Installation**
  - — mounting height
  - — spacing between units
  - — type of suspension
  - — surface mounting details
  - — recessed troffer types
    - — saddle-supported with ceiling flange
    - — snap-in type for ceiling channels
  - — pole, bracket or wall mounting (outdoor units)
- ☐ **Control Methods**
  - — standard switch or panel
  - — centralized remote
    - — standard voltage
    - — low voltage
  - — automatic control
    - — time clock
    - — photoelectric relay
    - — dimmer, manual or automatic
- ☐ **Fixture Details**

  General
  - — light source
    - — incandescent
    - — mercury-vapor
    - — fluorescent
  - — construction
  - — finish
  - — wiring
  - — shielding media
  - — number of lamps

  Component Parts
  - — ballasts
  - — fusing (heating, overcurrent)
  - — sockets
  - — other pertinent accessories
- ☐ **Luminaire Classification** (based on light distribution)
  - — direct
  - — semi-direct
  - — direct-indirect (general diffuse)
  - — semi-indirect
  - — indirect
- ☐ **Emergency Units**
  - — night lights
  - — exit lights
  - — directional lights
- ☐ **Hazardous Area Units**
  - — dust-tight
  - — vapor-tight
  - — explosion-proof
- ☐ **Outdoor Lighting Units**
  - — floodlighting and area lighting
  - — street and highway lighting
  - — protective lighting
- ☐ **Other items** pertinent to specific lighting design

A well planned, modern lighting system, for a majority of installations, must meet two design criteria. It must be functional and provide the desired illumination intensity with a maximum of visual comfort. It should blend with or become an integral part of the architectural design and the interior decor.

To accomplish this, lighting engineers make a judicious selection from the variety of lighting fixtures, light sources and components currently available. Also, they carefully plan the fixture layout with specific emphasis on such installation features as: mounting height, spacing between fixtures, support details, ventilation and ease of maintenance. All of these factors should be reflected by the lighting layout drawings and lighting specifications.

Ultimate success in attaining the desired lighting results requires that all light sources and lighting equipment be furnished and installed exactly as selected and specified. To insure that this is done, the designer (architect, engineer) should prepare a set of detailed lighting specifications complete with lighting plans and detailed drawings where necessary.

Lighting equipment normally is classified under two broad headings: 1) Luminaires—individual lighting fixtures or units, etc.; and 2) Lighting Equipment—components and lighting devices such as wiring channels, strip lighting, cove lighting, diffusing panels,

louvers, etc. (other than luminaires.)

All luminaires (for fluorescent, incandescent or mercury vapor light sources) may be classified under one of five basic types, based on their respective light distribution characteristics: 1) Direct—D; 2) Semi-Direct—SD; 3) General Diffuse or direct-indirect—G; 4) Semi-Indirect—SI; and 5) Indirect—I.

Standard specification paragraphs for the basic types of luminaires (for specific light sources) can be prepared easily by the specification writer, or can in most instances be obtained from the manufacturers of such luminaires. A number of typical specifications will be presented in this section.

Lighting equipment other than luminaires varies so widely in types and application that no attempt will be made here to provide prototype specification clauses for such equipment. When such items (cove lighting, special fixtures or luminaires, etc.) are to be furnished and installed, the specifier should detail the equipment on the drawings and prepare special specification paragraphs which describe the equipment in detail.

The five basic types of luminaires mentioned above vary widely in quality, design and physical appearance, mechanical features, materials, metal thicknesses, brightnesses, finishes, etc. For this reason, the specifier should give a specific detailed indication of the exact luminaires selected for each area of the lighting project. This may be done under any one of the following methods:

1. Use a lighting equipment manufacturer's name, trade name and/or catalog number to designate the exact luminaires wanted.

2. Give a description of the physical and photometric (light distribution) features of the exact luminaries wanted.

3. Describe the lighting result or illumination performance wanted from the luminaires.

Many engineers have considered the performance type of specification (method 3) but it is seldom used because of the difficulty experienced in writing a suitable, workable specification. It is not covered in this section.

The descriptive specification, method 2, is preferred over the performance type as a means of indicating luminaire selection to meet definite detailed structural standards and light distribution standards. It has the advantage (where this is desirable) of not mentioning a specific product by name and leaves it up to the various manufacturers to prove their products meet the detailed requirements of the descriptive specification. Prime disadvantage of this method is that it makes it somewhat more difficult for an electrical contractor to identify standard catalog items with the specifications when estimating the job or when ordering equipment unless the manufacturer produces assurances that his product meets the specifications.

Designation of a manufacturer's trade name and/or catalog number, method 1, to identify and establish luminaire quality is apparently the method preferred by a majority of engineers on private projects. As noted in numerous specifications, such clauses are short, concise and direct. They simplify a contractor's estimating and equipment purchase chore. An engineer's knowledge of and experience with one or more manufacturers' products leads him to use this method of establishing quality standards for specific luminaires. The listing of two or more trade names, or the addition of an "or approved equal" clause lifts the specification out of the "proprietary" class and permits normal competition. The specifications should definitely indicate which authorized person makes the final decision as to equality of equipment submitted for approval and the required steps for submitting alternate items.

Choice of method of specifying lighting equipment lies with the specification writer and should reflect the engineer's, architect's and/or owner's wishes. Both methods will be illustrated with typical clauses in this section.

7.1 General Conditions

General conditions for the Lighting section may include a number of specific items covered under General Conditions for the entire electrical specification (see Section 1.0). This may include such subjects as scope of work, materials and substitutions, workmanship, finishes, wiring and tests.

7.11 Scope of Work

State definitely in the specification who is to furnish the specified luminaires or lighting equipment. This can be included in a clause, as noted below, or reference can be made to the electrical specifications General Conditions (Section 1.12).

The electrical contractor shall furnish all luminaires, lighting equipment and components shown on the plans, listed in the "Fixture Schedule", and specified herein. He shall furnish all labor and materials to install the specified equipment in the manner indicated.

All luminaires and lighting equipment shall be delivered to the building complete with suspension accessories, canopies, hickeys, casings, sockets, holders, reflectors, ballasts, diffusing material, louvers, plaster frames, recessing boxes, etc., all wired and assembled as indicated. The electrical contractor shall furnish and install lamps and accessory wiring as indicated under the general provisions of the electrical specification.

7.12 Drawings

When special lighting equipment, other than standard catalog items, is specified, detailed drawings should be called for (see also Section 1.13, as follows:

Full size shop detail drawings of special luminaires or lighting equipment, where called for in the specifications, shall be submitted to the architect (engineer) for approval. When approved, they shall be returned with contract authorizing fabrication of equipment to be furnished.

7.13 Materials and workmanship

Statement to the effect that all materials shall be new and of best grade and of approved manufacturing standards. All workmanship to be first class and resultant product to be of the high quality type and finish as specified.

7.14 Finishes

Statement indicating manufacturer's standard finish, or details on special finishes wanted as noted in the specifications or Fixture Schedule.

7.15 Luminaire wiring

Insure safe fixture wiring with a paragraph similar to the following:

Luminaires with medium base sockets shall be wired with no smaller than No. 16, and mogul sockets with not smaller than No. 14, Type AF asbestos covered wire in accordance with latest requirements of the current edition of the National Electrical Code.

Fluorescent luminaires shall be wired with not smaller than No. 16 Type AF asbestos covered wire. No splice or tap shall be located within an arm, stem, or chain. Wire shall be continuous from splice in outlet box of the building wiring system to lamp socket, or to ballast terminals.

All fluorescent ballasts, as indicated, shall be of the high power factor type and their design and construction shall conform to the Certified Ballast Manufacturers' Standards.

7.16 Optional equipment

If bidders are to be permitted to quote on alternate or optional equipment in the original bid, or the successful electrical contractor is to be permitted to submit optional equipment for approval after the contract has been let, the exact basis on which such proposals are to be handled should be spelled out in detail in the specification. These proposals should conform to the statements and procedures covered in paragraphs 1.62—Specification by Brand Name, and 1.63—Material Substitution, under Section 1.0—General Conditions.

If provisions for Optional Equipment set forth in the specifications covering lighting equipment are meant to supersede General Conditions, this fact should be explicitly noted at the head of the relevant specification clauses.

A typical specification covering substitute equipment for inclusion in the lighting specifications might read as follows:

The following clauses shall supersede (supplement) relevant clauses in General Conditions section of the electrical specifications.

The original bid shall be based on furnishing and installing the luminaires or lighting equipment as specified.

With the original bid, the bidder may, if he so desires, submit an alternate proposal based on furnishing and installing luminaires or lighting equipment other than that specified. This alternate proposal shall contain detailed information (manufacturer's trade name and/or catalog number, construction details, data on light distribution, etc.) on the proposed substitute equipment and any price differential which would apply. Or:

Within (ten) days after award of the contract, the successful electrical contractor may make a written request to substitute comparable lighting equipment for that specified. Such an alternate proposal should clearly indicate any price differential which would apply; also detailed information on the proposed substitute equipment to permit a careful comparison with original specifications (luminaire construction, light distribution, etc.).

Any proposals for substitution of lighting equipment shall further meet all requirements of the provisions contained in paragraph 1.63 under Section 1.0—General Conditions of the electrical specifications.

Approval of specific lighting equipment substitutions shall be obtained in writing from the (architect, engineeer, owner) before equipment is ordered. Contractors seeking substitution of optional equipment shall be in a position to furnish samples of both specified and alternate equipment for comparison, if required.

7.2 Installation

An engineer's selection of luminaires and lighting equipment and his layout of such equipment is based on attaining a predetermined lighting result. Such installation details as type of mounting, distance between fixtures, mounting height of units, positioning of units, etc., have a very definite bearing on the final illumination intensity and coverage of the lighting system. This means that the equipment must be installed exactly as specified.

Specifications should include clear, concise installation instructions giving pertinent dimensional data, supporting details and any other information considered essential to assure proper installation. Types of lighting units and their installation may vary in different areas of a specific building. Where this occurs, separate instructional paragraphs for specific areas would facilitate estimating and field installation.

Relevant paragraphs from Section 6.0—Branch Circuits may be used as reference, or separate paragraphs may be added to the lighting specifications. For example:

All Type (identifying letter on plans) fixtures in the —— area (or see Fixture Schedule) shall be installed in continuous rows on —— ft centers. Bottoms of fixtures shall be —— ft, —— in. above floor level. Fixtures shall be mounted to (continuous-slot metal framing, trolley duct, angle or channel-iron supports, messenger cable, etc.) suspended from (or fastened to) structural steel at —— ft intervals.

7.3 Fixture Schedule

The increasingly large number of different types of luminaries and equipment appearing in modern lighting system designs complicates the problem of designating individual types on the plans and developing specification clauses for each. It is not unusual to find 25, 30, 50 or more different luminaire types used on a single project (stores, schools, etc.).

A preferred method of identifying a variety of luminaires on plans is to assign an identification letter (A, B, C, D, E, etc.) to each specific type and incorporate this identification in the luminaire specifications and in the Fixture Schedule.

A Fixture Schedule is a comprehensive listing, in capsule form, of all lighting fixtures to be installed, plus pertinent information relating to each. Schedule headings can be (reading from left to right): Type (A, B, C, etc.); Location; Quantity; Description (manufacturer's catalog number, etc.);

FIXTURE SCHEDULE

Type	Location	Quantity	Description	Lamps per Fixture				Mounting Height	Remarks
				No.	Type	Watts	Color		
A	Office	72	(Name), Cat. No. _____	2	96T12 Slimline		Cool White	10′-0″	Stem suspension
B	Factory	450	(Name), Cat. No. _____	2	40WT12 Rapid Start		Daylight	14′-0″	On continuous channel
C	Shipping	24	(Name), Cat. No. _____	1	Incand.	100	White	14′-0″	Self-aligning stems

Lamps (number, type, wattage, color); Mounting Height; Remarks (type of mounting, suspension, circuiting, etc.).

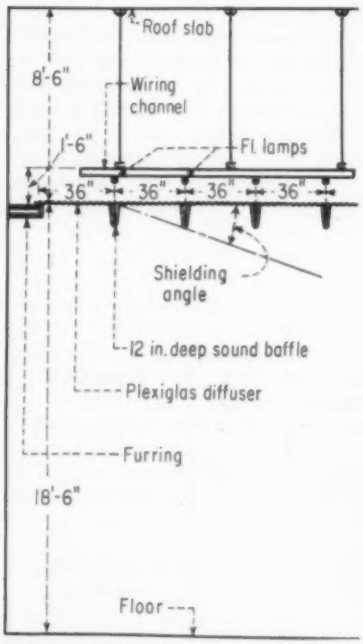
Fixture Schedules can be included in the pages of the specifications or placed on the plans as a supplement to specification clauses. In most cases, it is found on the plans, generally as a separate sheet listing all fixtures for the entire project. Frequently, these schedules are used as a basic guide for ordering lighting equipment.

Instead of showing one all-inclusive fixture schedule, some engineers include a smaller schedule on each sheet of the lighting plans. Such schedules list only the equipment to be installed in the area covered by that specific plan sheet. This approach eliminates the necessity of referring back to a master schedule each time lighting for a new area or floor is estimated or installed.

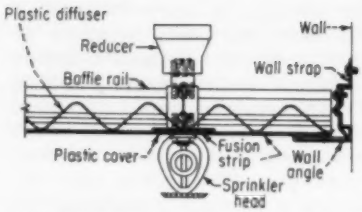
Whichever approach is used, the combination of an identifying symbol and a fixture schedule simplifies specifying a variety of luminaires.

7.4 Trans-Lighted Ceilings

Trans-lighted ceilings have opened a new approach to artistic and practical design treatment for lighting, sound (acoustic) control, climatic (air conditioning and electric heating) control, fire (sprinkler system) control, and to new concepts of flexibility and interchangeability in commercial and industrial areas.



INSTALLATION DETAILS and dimensions are important to good lighting results. Elevations like this insure proper installation of luminous ceiling.



INSTALLATION DETAIL of sprinkler head assembly protruding through trans-lighted ceiling installation. Sketches like this facilitate field work.

A recent trend in this type of lighting system design is to have the T-track grid or other supporting elements of the diffusing medium (glass, plastic, etc.) suspended from the electrical channels housing the wiring and lamp sockets. This design feature permits full integration of all parts of the lighting system by one sub-contractor under one contract responsibility. Where the large-area, self-contained panel units are used, complete with metal housing and diffusing media, this problem is solved automatically through full job jurisdiction by one contractor (electrical).

Most trans-lighted ceiling installations, classified as a direct (D) lighting system, are custom designed for a particular application or a specific job. Generally, standard lighting components are combined to compose the finished job. Specifications for this type of lighting should be custom prepared to meet the existing solution and existing installation conditions.

For specification purposes, ceilings formed of louvers (plastic, aluminum, steel, wood, glass, etc.) are also considered as trans-lighted ceilings. For all practical purposes, their construction, lighting characteristics and installation details are the same. For large-area self-contained units, consisting of housings, lamps and accessories, and diffusing medium, these may be treated similar to recessed lighting troffers or other individual type of lighting units.

Drawings should indicate, as far as possible, all details of construction and installation. These should be supplemented by complete written specifications to insure full quality of workmanship and materials as desired. Being an integral part of the structure, the architect or engineer should consider detailing most of the component parts as well as layout on the architectural, mechanical and electrical plans.

7.41 Trans-lighted ceiling specification

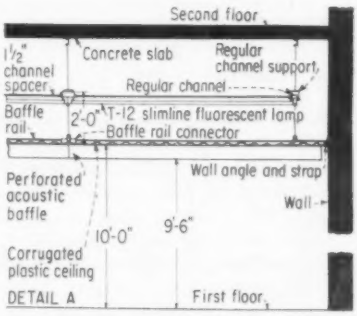
Detailed drawings may be supplemented by the following or similar specification clauses modified as required by structural or other conditions or any specific installation.

The electrical contractor shall furnish and install all wiring, wiring channels, housings, mounting frames and plastic (glass) diffusing panels for the trans-lighted ceiling as called for in these specifications and as detailed on the drawings.

Method of assembly is shown on drawing No. (——). Vinyl resin flexible plastic sheets (or acrylate corrugated plastic panels—give details) shall be held in place by T and U shaped channels formed of not less than No. 20 gauge steel, chemically treated to prevent corrosion, and provided with a high temperature baked white enamel finish. The projections supporting the plastic sheets shall have a 1-in. horizontal width as shown in the drawings. Channels shall be spaced as shown on drawing No. (——), and suspended as indicated by wire or adjustable metal straps in a manner that will maintain straight and level position.

Acoustical control, where called for, shall be obtained by the use of hollow perforated white-enameled metal fins (outline in detail any other method developed and wanted) containing a sound absorbing pad. Fins shall be supported at —— ft intervals from the U channels as shown and detailed on the drawings.

Lighting wireway channels and housings shall be installed in the plenum (space) above the suspended plastic ceiling so that fluorescent lamps will be —— in. above the plastic panels. Housings shall be supported from building slab by metal rod supports as shown on drawings. Spacing between lamp housings shall be —— in. as indicated. The suspended ceiling T and U bars shall in turn be supported from the wireway channels and lamp housings by steel straps approximately



SECTION THROUGH trans-lighted ceiling shows relative arrangement of components plus specific mounting heights and spacing. Note entire ceiling is supported by lighting units.

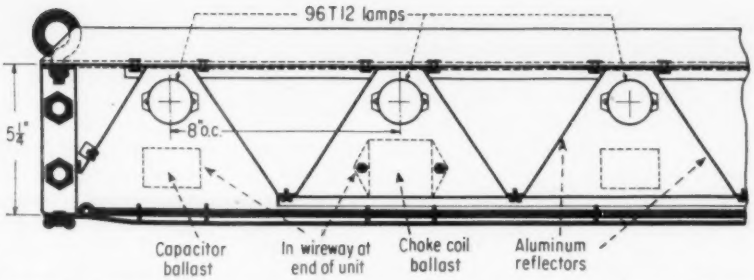
as shown. Contractor shall submit shop detail drawings indicating exact construction and gauges of metal housings, supports, etc.

Automatic sprinkler heads may also be mounted in the plenum above Vinyl resin plastic sheets, as approved by the Underwriters' Laboratories, Inc., and by the National Board of Fire Underwriters. Where acrylic plastics are used for diffusers, sprinkler heads may be mounted in U channels specifically designed for this purpose, or in suspended ceiling areas provided by the architect in the lighting layout design, or incorporated in the acoustical baffles (or otherwise as designed).

For acrylate plastics in corrugated, flat or molded patterns, and for metal or wood louvers, heavier supporting T bars and U channels should be used.

7.5 Special Lighting Fixtures

Where the lighting design incorporates luminaires or lighting equipment of such special nature that they are not standard manufactured catalog items, a much more detailed specification of the descriptive type is needed. This, of course, is supplementary to the detailed sketch or drawing that must be made to picture the engineer's concept of the new luminaire. Generally, a drawing will indicate type and size of structural components as well as overall physical appearance, dimensions and light distribution data. This information can be included in the descriptive specification, if considered pertinent to the specification.



DETAIL SECTION of special high frequency lighting fixture shows lamp, reflector and ballast arrangements. Drawings should be developed for all special luminaires.

Or, a specification for a special type of fixture can be relatively brief, as noted below.

7.51 High frequency luminaire

The electrical contractor shall furnish and install special design high frequency lighting fixtures as noted in the drawings. Fixture design shall be as indicated on Drawing No. ———.

Each luminaire, shall contain —— lamps, Type ——, operated at —— ma current, —— cycles, —— volts. Lamps shall be installed on —— in. centers.

One half of the lamps in each luminaire shall be controlled by a —— Company, Catalog No. —— choke coil ballast; the alternate lamps to have —— Company, Catalog No. —— capacitor ballasts.

The luminaire shall be constructed in two 4 ft by 8 ft sections and bolted together on the job to form an 8-ft square fixture.

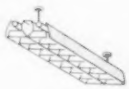
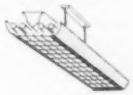
Each fixture shall be wired for two circuits, and shall be suspended from roof joists by —— chain so bottom of fixture is —— ft, —— in. above floor.

These special luminaires shall be as manufactured by the —— Company, or approved equal.

7.6 Luminaire Specification

As noted previously, writing specifications for standard type luminaires can be approached from three different viewpoints. The performance type was ruled out because of its difficult composition. The descriptive type presents detailed information on fixture construction, component parts and light distribution features. The "catalog designation" type is extremely brief and specifies a particular luminaire by manufacturer's trade name

LIGHTING SYSTEM CLASSIFICATION

TYPE	Direct	Semi-Direct	General Diffuse	Semi-Indirect	Indirect
					
UP	0-10%	10-40%	40-60%	60-90%	90-100%
					
					
DOWN	90-100%	60-90%	40-60%	10-40%	0-10%
SYMBOL	Type D	Type SD	Type G	Type SI	Type I

and/or catalog number. It is used primarily to establish a quality standard and is based on the logical assumption that a reputable manufacturer's product meets standard structural and photometric requirements for that particular luminaire.

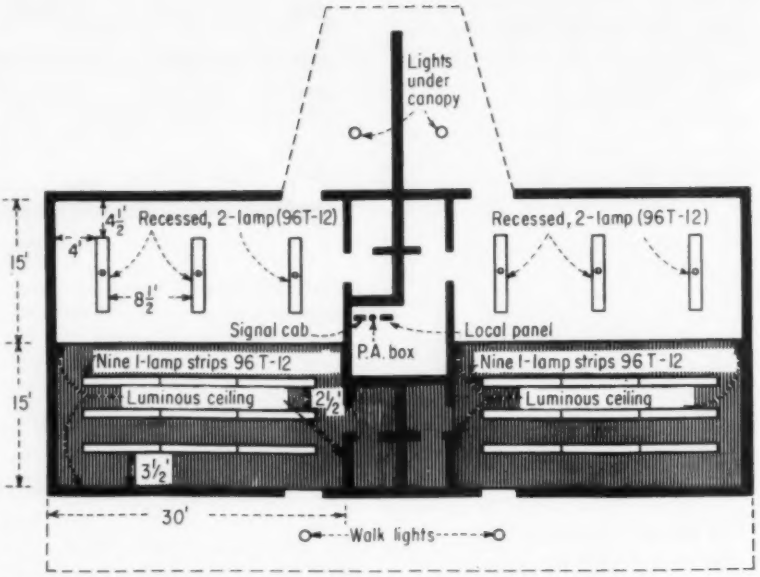
Examples of specification paragraphs of the two preferred types are presented below. Both cover luminaires of the semi-direct (SD) design for commercial application. Choice of method depends upon the specification writer (architect; engineer), his knowledge of and/or experience with standard catalog equipment and the method of handling approval of optional equipment.

7.61 Descriptive specification

Luminaires for the —— area, shall be of the semi-direct type such that approximately (10% to 30%) of the light output is in the 90° to 180° zone, and (60% to 90%) in the 0° to 90° zone. Luminaire shall be pendant (or surface) mounted. The overall efficiency in percent of bare lamp lumens shall be not less than (76%). The maximum brightness at any angle within the shielded zone shall not exceed 650 footlamberts. Moulded styrene resin (acrylate plastic, or diffusing glass) panels in combination with not less than No. 22 gauge durable etched and lacquered aluminum (or steel) louvers, finished in high temperature baked white enamel, shall constitute the shielding assembly. The louver assembly shall be a removable unit, firmly supported from the wiring channel and hinged from either side for simple and easy maintenance.

Wiring channel, reflectors, cover, and end plates shall be of not less than No. 20 gauge steel, chemically treated to resist corrosion and finished in high temperature white baked enamel. All exposed metal reflecting surfaces shall have a reflection factor of not less than (80%). Luminaires shall be designed for individual or continuous row mounting, and shall be for two (three, four) standard Type F fluorescent lamps (rapid start 40-watt, or Type T12 slimline, fluorescent lamps) as indicated on the drawings and listed in the Fixture Schedule.

All wiring shall be not less than No. 16 Type AF fixture wire. Ballasts shall be of the high power factor multi-lamp type meeting the Certified Ballast Manufacturers' standards. Starters (omit starters for rapid start and slimline lamps) shall be of the lock-out manually reset type. Entire luminaire and all component electrical parts shall be listed by the Underwriters' Laboratories as meeting National Electrical Code requirements.



LIGHTING UNITS should be accurately spotted on plans to assure best results. Typical dimensions on plans eliminate possible scaling errors.

7.62 Catalog designation

Fixture A (Schedule Symbol)—Commercial type (slimline) lighting unit with (two or four; as indicated) 96 in. 430 ma lamps per 8-ft section. Unit shall be provided with glass side panels, "egg-crate", hinged-bottom metal louvers with white baked enamel finish. Overall efficiency of the 4-light unit shall be not less than ——% when mounted on the ceiling.

Where indicated for emergency or night light use, the ballasts shall be arranged to permit control of one lamp separately from remaining lamps.

Ballasts in each unit shall conform to the Certified Ballast Manufacturers' standards.

Fixtures shall be as manufactured by the —— Company, Type ——, Catalog No. ——, or approved equal.
Or:

Type A—(Manufacturer's name), Type ——, Catalog No. ——, with four 96-in. T-12 slimline lamps per fixture.

Include specification for individual fixture fusing where desired.

7.63 Direct type luminaire

Where practically all of the illumination on the working plane is directed from luminaires in angles below the horizontal, a direct type (B) fixture is specified. The following paragraphs suggest typical points to be considered in writing specifications for this type of equipment.

7.631 Commercial fluorescent

A majority of this equipment application is of the recessed troffer type. Specifications and/or catalog designation should indicate the following: number, and size, and type of lamps; type of ballasts; whether troffer is to be snap-in type, or flange type with supporting harness; whether it is to be open type or equipped with drop-out louvers (metal, plastic), or have hinged frame containing diffusing medium (plastic, glass, etc.); also type of finish; type of installation (individual or continuous row).

For recessed troffer units incorporating air-outlet features, contact equipment manufacturers for detailed specifications.

7.632 Industrial fluorescent

Specification (or catalog designation) should cover the following: number, size and type of lamps, type of Certified ballasts (high power factor, rapid start, power-groove, etc.); type of RLM reflector noting percent upward component of light desired; reflector finish; whether reflector is to be open or equipped with louvers for additional shielding; whether units are to be dust-tight, vapor-tight, etc.; type of mounting; fixture wiring (for single or continuous row installation).

One specification arrangement follows:

Fixture B—Industrial type (slimline) unit with (two, three) 40-watt, 430 milliampere lamps as indicated. Unit shall be complete with porcelain enameled steel RLM, closed-end reflector

arranged for continuous row mounting. Lampholders shall be of one-piece, metal clad type which hold lamps under longitudinal spring pressure. Units shall be as manufactured by the —— Company, Type ——, Catalog No. ——, or approved equal.

7.633 Commercial incandescent

Accent units to be installed separately or in combination with fluorescent lighting system. Note whether recessed or the surface type. Give catalog number covering type of housing required for lamp size indicated; or write descriptive specification noting size, type and finish of housing, diffusing medium, lamp size, and other pertinent details.

7.634 Industrial incandescent

A wide variety of incandescent fixtures are available to produce a desired lighting result. Size and shape of the reflector body, plus finish of reflecting surface provide the three basic light distributions: wide spread; medium spread (semi-concentrating) and concentrating (intensive.) Fixture selection usually is based on illumination provided plus construction features facilitating installation, maintenance and replacement.

Specifications (descriptive or catalog designation) should cover the following luminaire features: size of lamp; reflector contour (standard or shallow dome, bowl, symmetrical or angle, flat cone, etc.); whether or not a diffusing globe, cover glass, or guard is necessary; steel or aluminum reflector construction; porcelain enamel, aluminum or Alzak aluminum, prismatic or mirrored glass reflecting surface; socket, reflector and hood assembly details; mounting details. Generally a catalog designation is sufficient to specify a fixture containing the desired features—including dust-tight, vapor-tight and explosion-proof types. All fixtures should meet RLM design requirements.

Fixtures should be included in the Fixture Schedule even if supplementary written specifications are provided.

7.635 Mercury-vapor

Mercury-vapor fixtures are usually selected and specified for lighting specific industrial areas. Usually, the 400-watt and 1000-watt units with medium and wide spread reflectors are recommended for medium and low bay areas, or for high bay areas when concentrating type reflectors are used. Where mounting heights are to be 35 ft, or more, above the floor, the 3-kw mercury-vapor lamps in concentrating or spread type reflectors find common application.

Where color discrimination or stroboscopic effect is a problem, alternate spacing of equal-wattage incandescent and mercury-vapor units, or combination mounting on a twin assembly is frequently specified. Color corrected mercury-vapor lamps, or m-v lamps with recently developed special coatings may help solve these problems in a more economical manner.

Specifications for mercury-vapor equipment should cover: size of lamp, type of reflector (medium, wide spread, concentrating); reflector construction (steel, aluminum, prismatic or silver mirrored glass) and reflecting surface finish (porcelain enamel, etc.); socket and hood construction (vented, non-vented); open or glass-covered reflector; and other pertinent features. Generally, a single catalog designation will cover a specific unit.

Mercury-vapor reactor or transformer equipment is not integral with the fixtures and must be mounted at or near the fixtures. Specifications should give mounting details for such accessory equipment to supplement data on the electrical plans. Relevant notes pertaining to this and any fixture lowering devices (for any high bay units where indicated) can be added in the "Remarks" column of the Fixture Schedule.

7.636 Reflector lamps

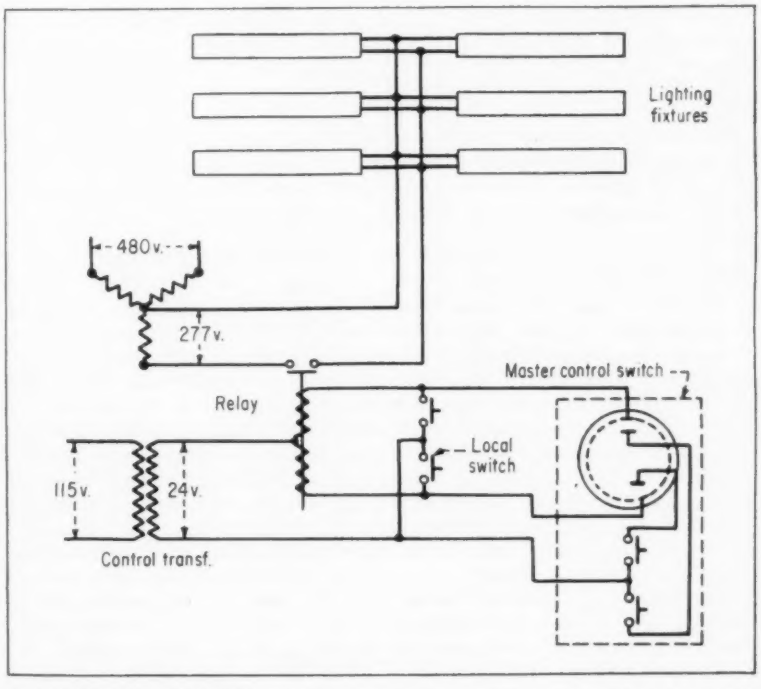
No separate reflector or luminaire is required where reflector lamps, of the incandescent or mercury-vapor type, are indicated in a lighting system. Such lamps have a self-contained reflector in the bulb itself and frequently are used in non-hazardous areas where the atmosphere contains considerable smoke, dirt, or dirty non-explosive fumes. They are less costly to maintain because there is no reflector to catch and concentrate the atmospheric contaminants.

Such lamps do require a mogul screw shell socket assembly and a mounting or suspension arrangement which should be detailed on the plans.

Reflector lamps should be specified by wattage and bulb designations as provided by the lamp manufacturers. The entire assembly should be given a Type symbol and listed in the Fixture Schedule.

7.64 General diffuse

General diffuse luminaire classification (G) covers direct-indirect units which provide illumination of a general diffuse character by having almost equal amounts of light emitted from the top and bottom of the fixture (40% to 60% up, 40% to 60% down). To attain this result, fixtures are normally suspended at various distances from the ceiling. When this type of unit is



LOW-VOLTAGE CONTROL of 277-volt lighting system is simplified by simple wiring diagram of typical circuit and control connections.

surface-mounted it can be classified as semi-direct (SD) since the reflected ceiling component is reduced.

Luminaire specifications should include: number, size and type of lamps; type of side panels (plastic, glass); type of bottom louver section (metal, plastic, etc.) and whether of hinged or drop-out type; degree of shielding desired; type of finish; type of ballast (high power factor, Certified, etc.); type and length of hangers or suspension facilities. Whether unit is for separate or continuous row installation should also be indicated.

A single catalog designation can be used to specify a particular unit, or descriptive specification paragraphs can be written. Fixtures should be given a plan symbol and listed in the Fixture Schedule.

7.65 Semi-indirect

Luminaires in the semi-indirect (SI) classification provide from 60% to 90% of their light output from the top of the fixture (above the horizontal). These, too, must be pendent mounted from the ceiling. Some luminaires with direct-indirect (general diffuse) design and structural characteristics, but with four to six lamps, will—because of their wider top opening—meet the zonal distribution requirements of the semi-indirect classification. Care should be taken that the bottom shielding medium will confine maximum brightness within prescribed limits.

Specifications should cover all the pertinent facts enumerated for the general diffuse units (Section 7.64). In like manner, a catalog designation can be used to specify a particular luminaire, or descriptive specification paragraphs can be written. Fixtures should be given an appropriate plan symbol and listed in the Fixture Schedule.

7.66 Indirect luminaires

Indirect luminaires provide from 90% to 100% of their light output from the top of the fixture (above the horizontal). The light is diffusely reflected from the ceiling and side walls. Length of pendent suspension is important to the lighting result and must be carefully specified. Some fixtures with plastic enclosures may provide a greater downward light component than noted above, but still be considered in the indirect classification.

Specifications similar to those for semi-direct or direct-indirect units can be used with an additional paragraph covering the (metal, plastic, etc.) reflector medium. Luminaires should be listed in the Fixture Schedule.

7.7 Emergency Lighting Units

Lighting units for emergency systems may include any size, shape or design within the limits set by local or other applicable codes. Check those regulations before specifying units. Fixtures may be individual units (exit lights, illuminated directional signs, etc.) or may be combined with general lighting luminaires (night lights, emergency lights) but served by emergency circuits.

Specification paragraphs can be written for each type of emergency lighting unit with a clear statement that these units are to be connected to the emergency circuits noted elsewhere in the electrical specifications.

Emergency lighting units should be listed in the Fixture Schedule and detailed on the drawings to indicate any unusual construction or installation features.

7.8 Hazardous Area Lighting

Selection of lighting equipment for hazardous areas in a specific installation should be based National Electrical Code classifications for the degree of hazard determined by local inspection authorities. Once this is established, Code recommendations should be followed and dust-tight, vapor-tight or explosion-proof equipment specified as required. It is good practice to have on file manufacturer's detailed specifications of equipment involved.

To insure that the selected equipment is furnished and installed, the lighting equipment specification should include manufacturer's name, catalog number and a general description of the item. Several manufacturers can be listed, or an "approved equal" clause can be added to conform to competitive requirements.

7.9 Exterior Lighting

Many types of outdoor lighting equipment are available for floodlighting buildings, outdoor recreational, storage and parking areas, protective lighting, and street and highway lighting. Luminaire selection is based on the construction and light output (type of beam, photometric performance) characteristics of the specific unit and the physical characteristics of the area to be illuminated.

No attempt will be made here to provide standard specifications for all types. There are too many. Instead, major points to be covered by a specification will be mentioned and followed by a selected number of typical specification paragraphs which can be modified as required.

A luminaire or fixture specification should include: lamp size (watts) and type (incandescent, mercury-vapor, fluorescent); type of circuit (voltage, multiple or series, etc.); fixture construction (enameled steel, aluminum, open, closed, etc.); type of beam (medium spread, wide spread, narrow or concentrating, etc); finish of reflecting surface; type of mounting (pipe, pole, wall, cross-arm, etc.). If a lowering device is required, specify same.

In most cases, a catalog designation will suffice to indicate a fixture incorporating all the features desired. Luminaires should also be given a plan symbol and listed in the Fixture Schedule, preferably in a separate group. In like manner, outdoor lighting specifications should be separate from interior lighting system specifications.

Where outdoor lighting units are to be automatically controlled, specify type control (time clock, photo-electric relays, etc.) and location. Do the same for any ballasts, transformers or other accessories required by the selected fixtures.

The following specification clause could apply to all units. This would be followed by individual paragraphs for specific fixtures.

The electrical contractor shall furnish and install floodlight (street lighting) units of the type and size indicated on the drawings, listed in the Fixture Schedule, or specified herein. All luminaires shall meet NEMA design and photometric standards.

7.91 Floodlighting

Fixture (fixture schedule symbol) shall be —— Company, Type ——, Catalog No. ——, or approved equal, for operation with (size, incandescent, mercury-vapor, fluorescent) lamp on —— volt circuits. Units shall be mounted ——ft above the ground on (steel, aluminum, concrete) poles, or on building walls, as indicated on the drawings and in the Fixture Schedule. Ballasts or transformers (where required by fixture type) shall be installed as indicated on the drawings; and shall be —— Company, Type ——, Catalog No. ——, or approved equal.

7.92 Street lighting

The above skeleton specification can be modified as needed to indicate specific types of street lighting units. Additional information relating to multiple or series circuits should be included. Or, more detailed specifications for this type of luminaire can be secured from the equipment manufacturers.

Add pertinent clauses about type of control equipment, mounting details.

8.0 Motors, Generators and Controls

- ☐ **Motors and Generators**
  - Equipment to be -furnished, -set, -connected
    - — by owner
    - — by other contractor
    - — by electrical contractor
- ☐ **Type**
  - — direct current
  - — squirrel cage
  - — wound rotor
  - — synchronous
  - — motor-generator set
  - — special type
- ☐ **Characteristics**
  - — voltage
  - — phase
  - — frequency
  - — horsepower
  - — amperes, full-load
  - — speed
  - — torque
  - — NEMA design letters
  - — enclosure (open, drip-proof, splash-proof, explosion-proof, etc.)
  - — special characteristics
- ☐ **Installation**
  - — on machine
  - — on sliding base
  - — on foundation
  - — method of coupling
  - — connection details (terminal box, flexible conduit, etc.)
- ☐ **Other items** pertinent to specific design and application

- ☐ **Controls**
  - Equipment to be -furnished, -set, -connected
    - — by owner
    - — by other contractor
    - — by electrical contractor
- ☐ **Type**
  - — disconnect, -starter, -controller
  - — manual
  - — magnetic
  - — line voltage
  - — reduced voltage
  - — integral control
  - — remote control
  - — accessory switches (limit, pressure, float, etc.)
  - — plugging switches
  - — timing devices
  - — reversing
  - — NEMA type enclosure
- ☐ **Characteristics**
  - — voltage
  - — phase
  - — number of poles
  - — ampere capacity
  - — protection
- ☐ **Installation**
  - — at machine, -on wall, -on special rack
  - — in a group (give details)
  - — in a control center
  - — remote control units and relays
  - — connection details (between control unit and motor)
- ☐ **Other items** pertinent to specific control system

Electrical specifications for any job —industrial, commercial or residential —should include detailed information on motors, generators and their related switching and control equipment. Such information is logically grouped in one section of the specification because it involves a wide range of data on closely related factors.

Usually, installation techniques, code considerations and equipment layout follow more or less a pattern throughout the entire job; and the installer thinks of motor installation as a type of work. For these reasons, conditions and requirements which apply to motors and motor control might be separated in a section entitled "Motors and Controls" or "Motors, Generators and Controls". Of course, exact title and layout for the section will depend upon the nature of the job and particular conditions which prevail. The number, type, sizes and locations of motors, generators, and their associated controls will vary greatly from job to job.

Specifications for motors and generators and the related control equipment should cover the following considerations:

1. Who is to furnish the equipment; who is to set or mount it; and who is to install or connect it.

2. What are the physical characteristics, sizes, ratings and performance capabilities of the equipment.

3. What particular installation requirements are involved—mounting details, connecting methods, protective guards, type of coupling to machines, etc.

The amount of specification detail covering the installation of motors, generators and their controls will depend upon how the first of the above considerations is resolved. Where the equipment is to be furnished by others but installed as part of the electrical contract, the specifications should cover size of equipment plus data on

the wire, conduit and other devices which are furnished and installed by the electrical contractor.

When equipment is furnished as part of the electrical contract, specification clauses should clearly and completely describe the equipment. In all cases, however, the specifications should contain sufficient detailed information to complement the data given in the electrical plans and to clarify any points open to possible question.

The following outline covers a wide range of possible data for electrical specifications covering motors, generators, and their controls. Some of the suggested entries may duplicate data presented in other parts of the specifications, such as General Conditions or Scope of Work. However, important instructions to the contractor should be repeated where they will eliminate confusion, misunderstanding and possible costly errors on the job. Paragraphs in boldface type are examples of typical specification clauses.

8.1 Furnishing Equipment

State definitely who (owner, machinery manufacturer, other subcontractor, electrical contractor) furnishes the various motors, motorized equipment, generators, motor controllers, associated control devices and disconnect switches. This may also be covered under Section 1.0—Scope of Work.

The electrical contractor shall furnish and install all electric motors and controllers as shown on the plans; also a disconnect switch for each motor where indicated; also the required feeders and control circuits, as indicated on the plans, to operate the motors.

Such a general clause can be supplemented with relevant clauses (see Section 6.0—Branch Circuits) covering type of circuit (raceway, cable, etc.) to specific motors and equipment.

8.2 Installing Equipment

If the motors and controls are to be furnished by "others" (not the electrical contractor) the specifications should clearly state who is to receive, handle, set, mount and install such equipment. The idea is to establish a definite starting point for motor work covered by the electric wiring contract.

All motors and controls to be furnished by (name, others) shall be delivered to the receiving dock at the job site. Unless otherwise noted, the electrical contractor shall receive, handle, set, mount and install this equipment where indicated on the plans including all necessary feeder, control and protective circuits.

8.3 DC and Induction Motors

Give motor characteristics in equipment specifications.

8.31 DC motor

Manufacturer's type and frame designation, horsepower output, time rating, temperature rise, rpm at full load, voltage, full-load amperes and winding—shunt, compound or series, also type of insulation and bearings.

8.32 Polyphase squirrel-cage

(Also to describe ac single-phase motors.)

Manufacturer's type and frame designation, horsepower output, time rating, temperature rise, rpm at full load, frequency, type of insulation, type of bearings, number of phases, voltage, full-load amperes and "code" designation of locked-rotor kva per horsepower.

NEMA design letters for integral-horsepower motors—locked-rotor and breakdown torques; locked-rotor current; and percent slip at rated load.

8.33 Polyphase wound-rotor

Cover items given above for polyphase squirrel-cage motors, plus secondary amperes at full load and secondary voltage.

8.34 Small units

Motors rated less than 1/20 hp—complete motors sold separately as motors. Indicate type designation, power output (millihorsepower—mhp), full-load speed, voltage rating, frequency, number of phases and type of overheating protective device.

8.35 Universal motors

Manufacturer's type and frame designation, horsepower output, time rating, rpm at full load, voltage, full load amperes and frequency (60/dc is recommended form).

8.36 Applications

General-purpose; definite purpose; or special-purpose motor.

8.37 Mechanical protection

Also describe type of enclosure: drip-proof; splash-proof; semi-protected; protected; drip-proof fully protected; open externally-ventilated; open pipe-ventilated; totally-enclosed non-ventilated; totally-enclosed fan-cooled; explosion-proof; dust-explosion-proof; water-proof totally-enclosed pipe ventilated.

8.38 Speed characteristic

Constant-speed; varying-speed; adjustable speed; adjustable varying-speed; multi-speed.

8.39 Miscellaneous data

Efficiency; power factor; service factor; various torques—full-load, locked-rotor, pull-up, breakdown, pullout, pull-in.

Motors for operating (————) shall be of the polyphase squirrel-cage induction type rated for ——— hp, ——— volts, ——— phase, ——— cycles, ——— rpm, NEMA design (A, B, C, D, E, F,) with Class —— insulation and ——— bearings. Enclosure shall be (open drip-proof, splash-proof, fan cooled totally-enclosed etc.) for ——— degree C continuous temperature rise, with (normal or quiet) operation. Frame number shall be ——— with the following dimensions: ———.

8.4 Synchronous Motors

8.41 Separately excited

Revolving field (rotor) or stationary field (stator).

Manufacturer's type designation and frame number. Horsepower output, time rating, temperature rise, rpm at full load, frequency, number of phases, voltage, rated amperes per terminal, rated field current, rated exciter voltage, rated power factor and torques (percent of rated full-load torque)—locked rotor, pull-in and pull-out.

Motors for operating (————) shall be of the synchronous (engine, coupled, belted) type arranged for (horizontal, vertical) operation and rated at ——— hp, ——— volts ——— phase, ——— cycles, ——— power factor, with a starting torque of ———% full-load torque, a pull-in torque of ———% full-load torque. Motor and its control shall limit kva inrush at starting to———% full-load kva.

Excitation for the motor field shall be from a (direct-connected exciter, belted exciter, motor-generator set, dc bus).

Maximum temperature rise for the stator shall be —— degrees C; for the field,—degrees C. Maximum excitation required shall be ——— kw at ——— volts. Efficiencies at ———% power factor shall be: ——— for full load, ——— for ¾ full load, ——— for ½ full load.

8.5 Generator Characteristics

8.51 DC general purpose

(Up to 150 kw).

Manufacturer's type designation and frame number, kilowatt output, time rating, temperature rise for rated continuous load, rated speed in rpm, voltage, rated current in amperes, winding—series, shunt or compound, excitation voltage, or self-excited and recommended value of resistance for rheostat for hand or regular control of output.

8.52 Large dc units

Larger than general purpose (over 150 kw).

Manufacturer's type designation and frame number, kilowatt output, time rating, temperature rise for rated continuous load, overload, time rating of overload, temperature rise for overload, rated speed in rpm, voltage rating, rated current in amperes and winding—series, shunt or compound field winding.

8.53 Synchronous

Manufacturer's type designation and frame number, kilovolt-ampere output, power factor, time rating, temperature rise for rated continuous load, rated speed in rpm, voltage, rated current in amperes per terminal, overload, time rating for overload, temperature rise for overload, number of phases, frequency, rated exciter voltage and rated field current.

8.54 Motor-generator sets

(Induction or synchronous direct-current).

Motor voltage, horsepower, number of phases and frequency, kilowatt and speed rating, frame type, power factor and generator voltage.

8.541 Emergency generator set

Give detailed information on engine drive (gasoline, gas, diesel, etc.), hp size etc.; also size and electrical characteristics of generator; also details of associated control. See Section 2.131 (Standby Generator) for prototype specification.

8.542 Rotary frequency converter

The electrical contractor shall furnish and install (number) ——— kw, motor generator frequency converter(s) which will provide ——— cycle, ——— volt power for the high frequency lighting system. The ——— cycle generator phases shall be center tapped to ground so that the voltage will not exceed ——— volts to ground. Each unit shall be a self-contained m-g set with associated control equipment contained in an all-metal drip proof cabinet. Each unit shall include the following components:

One induction drive motor ——— hp, Type ———, ——— rpm, ——— volts, ——— phase, 60 cycle integrally connected to:

One synchronous generator ——— kva, Type ———, ——— power factor, ——— rpm, ——— volts, ——— phase, ——— cycle, with overhung exciter.

One input fused disconnect switch, ——— amp, ——— volt, ——— pole, ——— phase, 60 cycle.

One full-voltage motor starter with overload and under-voltage protection rated for the motor.

One voltage regulator.

Three output fused disconnect switches rated ——— amp, ——— volt, single-phase, 2-pole, ——— cycle.

The packaged rotary frequency converter units shall be as manufactured by the ——— Company, or approved equal.

8.6 Motor Controls

Where several motors of like capacities, design, characteristics and application are to be installed, detailed control specifications could be included with the motor specification clauses. When numerous motors of widely differing capacities, characteristics and functions are to be installed, a general specification could be written to cover motor control equipment with additional clauses relating to those installations which do not follow the pattern.

Such general specifications could follow the outline presented below. This includes only the more common types of general-purpose motor control devices for alternating current motors. It is well to consult the manufacturers before specifying control equipment for special applications.

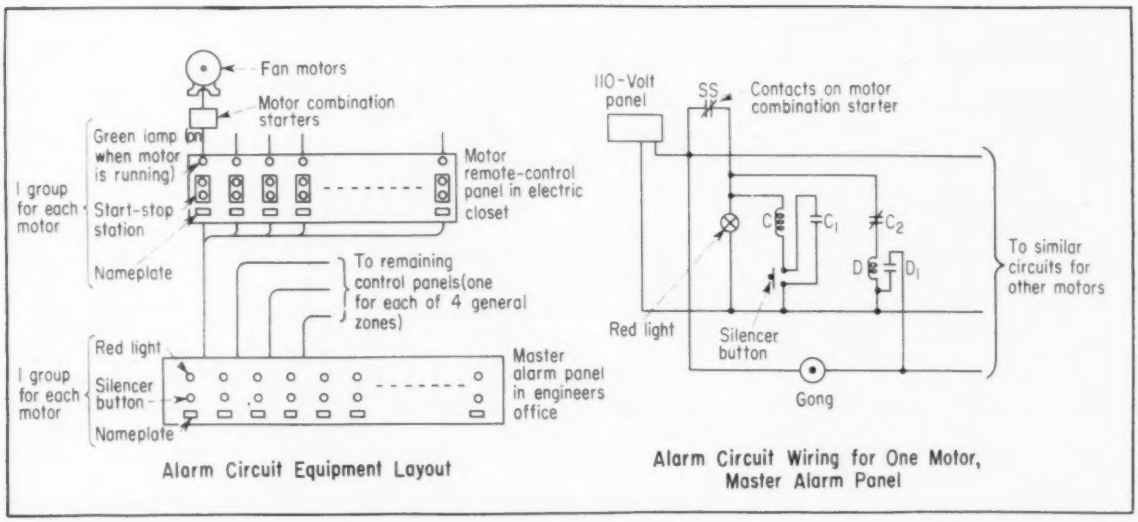
In any case, control device specifications should reflect the careful selection of equipment to match the control problem at hand.

8.61 Direct-current

Consider all of the following items:

Type: across-the-line, start-stop (and reverse), standard or heavy duty automatic reduced voltage.

Horsepower rating and type of motor controlled. Line voltage and motor amps.



SIMPLE DRAWING presents motor remote control equipment layout and circuit diagram for audio-visual alarm system for fan motors in a large commercial building. Detail plans like this complement specification clauses.

Type of enclosure: NEMA Type I, Standard; Type II, Drip-tight; Type III, Weather-resistant; Type IV, Watertight; etc.

Overload protection, reset button.

Pilot device, pushbutton station; float switch, thermostat; etc.

Automatic operation; accelerate shunt, series and compound motors; accelerate shunt and compound motors; not suitable for jogging; etc.

Time limit of automatic operation: designed for one 10-second start out of each 80 seconds.

For constant speed or adjustable speed motor, number of accelerating points.

Non-reversing, with or without braking; reversing with braking.

Field accelerating and decelerating relays.

Low voltage protection.

Field rheostat: manual, enclosed, for prescribed speed range of particular size motor.

Other relays: control, field protective, field failure.

8.62 Alternating-current

Consider all of the following items:

Type: across-the-line, manual starting switch; across-the-line, magnetic switch; reduced voltage starter.

Horsepower rating and type of motor controlled.

Line voltage, frequency, full-load motor current and number of phases.

Type of enclosure: NEMA Type I, Standard; Type II, Drip-tight; etc.

Overload protection.

Pilot devices: pushbutton station; control switch; relay; thermostat; etc.

Number of poles.

Reversing.

Combining disconnect switch (or circuit breaker) in the same enclosure, with or without fuse clips for specific rating.

No voltage protection.

Maximum primary running current, for primary control of slip-ring motor.

For constant-speed or adjustable-speed motor operation.

Relays: automatic reset; low speed start; accelerating; decelerating; etc.

For multi-speed operation: consequent pole or separate winding; constant torque, variable torque or constant horsepower.

Reduced voltage starters: manual (resistance, or autotransformer) type; magnetic (resistance, three-point resistance, stepless resistance, or transformer) type.

For reduced voltage operation: particular conditions of the starter application—characteristics of driven machine, hookup of pilot devices, frequency of starting.

Synchronous motor starters: semi-magnetic, reduced voltage, autotransformer type; reduced voltage, autotransformer type; reduced voltage, resistance type; magnetic, full voltage, across-the-line type.

For synchronous motor starters: kva, rpm, power factor, full load amperes, phases and frequency, voltage, field voltage, excitation amperes, size and rating of field discharge resistor.

Squirrel-cage motor starters for high voltage: across-the-line type; reduced voltage, autotransformer type.

For high voltage squirrel-cage motor starters: locked rotor current of motor.

Reversing drum switches for starting and reversing squirrel-cage motors, for ac or dc, with spring or non-spring return, for surface, panel or switchboard mounting.

Multi-speed drum switches for manually starting, speed changing and reversing 3- and 2-phase multi-speed motors (reversing or non-reversing).

Non-reversing drum switches for polyphase wound-rotor induction motors, for starting and speed regulating —with grid resistors and characteristics matched to motor operating conditions.

8.63 Motor control devices

Consider all of the following:

Manual speed regulators.

Pushbutton: standard duty, heavy duty, oiltight stations, etc.

Limit switches: ac, dc, precision.

Plugging switches.

Overload relays: thermal, magnetic.

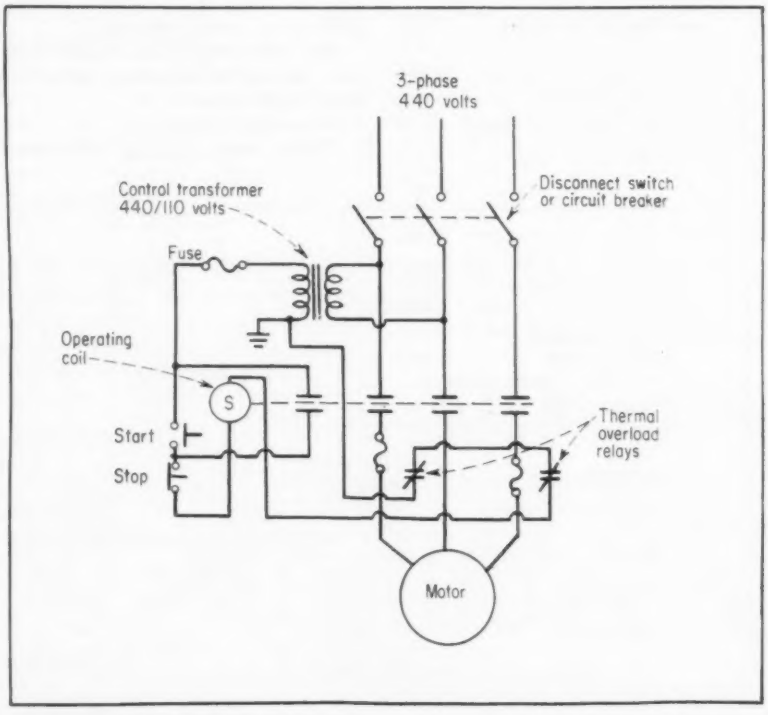
Switches: pressure, temperature, float.

Timing relays: pneumatic, fluid dashpot, motor-driven, electronic, etc.

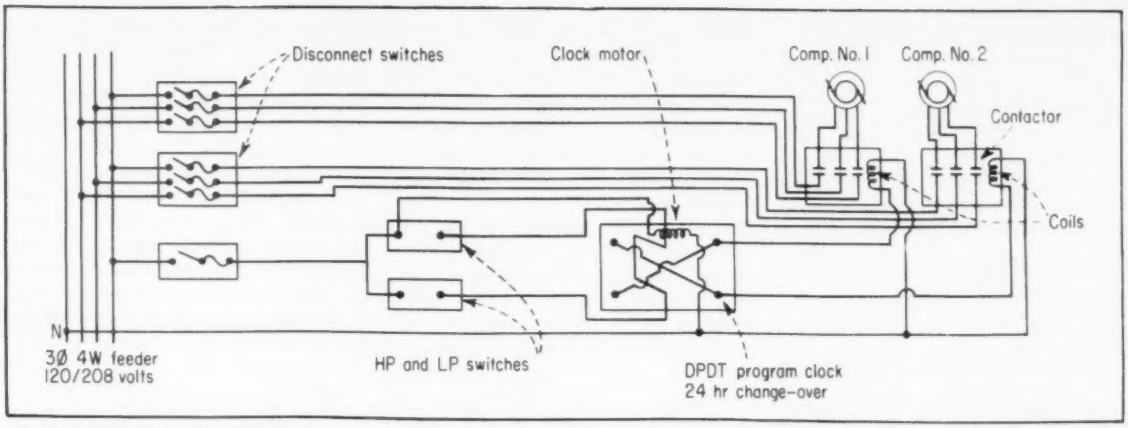
Depending upon equipment selection and system design, a motor control specification might consist of one or more of the following typical clauses.

Controls for (fan, pump, etc.) motor shall provide for (full, reduced voltage) starting of the ——— hp, ——— rpm, ———% pf, ——— volts, ——— phase, ——— cycle motors. Controls shall be in NEMA I enclosures, and designed for (full magnetic, semi-magnetic) operation. Reduced voltage at starting shall be obtained by means of (autotransformer, reactor, resistor) and shall limit the kva inrush to a maximum of ———% of full load kva.

The control shall provide overload, undervoltage, damper winding and pullout protection and, after pull out of step, shall automatically stop (or



CONTROL TRANSFORMER connected to load side of 440-volt motor disconnect switch provides 110 volts for motor control circuit. Opening switch kills motor and control circuit for maintenance.



SPECIAL CONTROL SCHEMES like this timeswitch changeover of two air compressors should be clearly specified and detailed on the electrical plans.

re-synchronize) the motor. Control shall be as manufactured by ———, Type ———, or approved equal.

Controls for squirrel-cage motors shall be combination 3-pole across-the-line starters with circuit breakers in NEMA Type ——— enclosures with self-indicating handles and shall provide overload, low voltage and short circuit protection. Breakers shall trip at ——— amps. Remote 2-unit standard-duty pushbutton stations, momentary contact, marked 'Start-Stop," shall be provided in NEMA Type ——— enclosures. Starters shall be as manufactured by ———, Class ———, Type ———, or approved equal.

Each motor rated 1/6 hp or over shall be equipped with a starter or controller providing running overcurrent protection for the motor. Overcurrent devices shall open all leads to the motor except that for 2-phase motors, only three leads are required to be opened. All starters and controllers shall be in metal enclosures and shall conform to NEMA Industrial Control Standards.

Type A starters shall be manually operable for full-voltage starting by means of a lever, knob or pushbutton.

Type B starters shall be magnetically operable for full voltage starting; shall have undervoltage protection and provision for connection of remote control stations.

Type C starters, for reduced-voltage starting, shall be of the manually operable autotransformer type. Each starter shall have undervoltage protection and a stop pushbutton in the cover.

Type D starters, for reduced voltage starting, shall be of the magnetically operable autotransformer type. Each starter shall have under-voltage protection and provision for remote control.

Type E starters are for wound-rotor motor starting duty only. Each controller shall have a magnetically-operated primary switch and a resistor switch with suitable resistors. The primary switch shall provide running overcurrent and undervoltage protection for the motor. An electrical interlock between primary and resistor switches shall prevent closing primary switch unless all resistors are connected. Resistor switches shall be dial type for motors of 10 hp or less; drum type for larger motors.

Type F controllers are for wound-rotor motor speed regulation duty. They shall provide for 50% speed reduction and continuous operation at any speed from maximum to minimum. In all other respects Type F controllers shall conform to Type E starter specifications.

8.7 Installation Details

8.71 Special drawings

Motor and control wiring diagrams for special or complex control.

Details of equipment mounting and arrangement.

8.72 Wiring instructions

Supplementary instructions to contractor relating to special drawings or special wiring techniques.

8.73 Type of feeders

Conduit, busway, etc. (See Sections 5.0 and 6.0 for typical specification clauses.)

8.74 Motor installation

As shown on plans, or with changes indicated. Give details on specific machines: motor placement for maintenance ease; type of drive (sheaves and belts, sprocket and chain, etc.) and protective guard details; vibration-proof flexible circuit connections; over-size terminal boxes; oil-tight flexible connections; slack for adjustable-base motors, etc.

8.75 Controller installation

Location of controllers: position, mounting height, support and enclosure details; grouping in control centers; arrangement of controller groups; control relay and auxiliary device installation and connections.

All control equipment shall be mounted with operating levers or pushbuttons approximately ——— ft above the floor. All necessary expansion bolts, brackets and other structural steel parts shall be furnished to provide secure mounting on walls, columns, special racks, or machine frames as indicated on the drawings.

All fans and other motorized equipment as shown in the feeder diagrams and schedules shall be provided with auxiliary relays at starter locations and necessary control connections to master pilot light and control panel in engineer's office. There shall be one pilot light for each fan motor indicating when that motor is operating.

Start-Stop remote control pushbuttons shall be provided under the respective pilot lights for each cooling tower fan motor on the roof. For all other fan motors, a "Stop" pushbutton station shall be provided under pilot lights in the master control panel.

8.76 Disconnect switches

The plans and specifications should reflect NEC regulations relating to disconnect switches on motor circuits. Indicate clearly whether required disconnects are to be furnished and in-

stalled as separate switches or are to be included in combination motor starters as noted on plans. See Section 4.0 (4.7—Safety Switches) for typical disconnect switch specification.

Except as otherwise noted, the electrical contractor shall furnish and install a manually operable disconnecting means for each motor, or each group of motors on a single machine.

8.77 Installation specification

An installation specification covering a number of the above items might read as follows:

Motors shall be located as indicated on the drawings and set so as to permit unhindered maintenance, bearing lubrication and brush replacement. Totally-enclosed motor housings shall be used where conditions of excessive moisture, steam, dripping oil, dust, acid fumes or explosive atmospheres exist.

Starting device, controller, relay, thermostat and photocell switch circuits shall be installed in (rigid or flexible metal conduit, armored cable, EMT). Where motors have conduit terminal boxes, feeders shall be connected to same by flexible means.

All motors with sliding base mounting shall have not less than 18 in. nor more than 6 ft of flexible conduit connecting rigid conduit feed to motor terminal box. Power supply leads from controllers to motors shall conform to drawings and recommendations.

Stationary motors operating at more than 150 volts to ground shall have grounded frames when: (1) located in unguarded, moist locations; (2) connected to metal-enclosed wiring branch circuits; and (3) located in hazardous areas. Motors shall be grounded by approved methods.

9.0 Air Conditioning, Heating

☐ **Air Conditioning and Ventilation**

☐ **Equipment**
- To be furnished
- — by others
- — by electrical contractor
- Electrical characteristics
- — horsepower of motors
- — full load amps of motors
- — voltage, phase, frequency
- Type of unit
- — conventional fans or blowers
- — central system
- — window unit
- — console assembly
- — heat pump, reverse cycle

☐ **Controls**
- To be furnished
- — by others
- — electrical contractor
- Electrical characteristics
- — voltage, phase, frequency
- — wattage, amperes
- — thermal and overcurrent protection
- — operating temperature range
- Type
- — manual, automatic
- — single, multi step or speed
- — line, low voltage with transformer and relays
- — surface, flush mounting

☐ **Installation**
- — mounting dimensions
- — special circuiting or control
- — detail drawings
- — equipment schedule

☐ **Other items** pertinent to system design

☐ **Electrical Heating**

☐ **Equipment**
- To be furnished
- — by others
- — by electrical contractor
- Electrical characteristics
- — wattage of units
- — voltage, phase, frequency
- — heat output, Btu/hr.
- Type of unit
- — baseboard, radiant and convection
- — wall panel, radiant, metal, glass
- — wall panel, forced convection (with fan)
- — heating cable, radiant
- — unit heater, fan circulation
- — heat pump
- — auxiliary units for air ducts

☐ **Controls**
- To be furnished
- — by others
- — by electrical contractor
- Electrical characteristics
- — voltage, phase, frequency
- — wattage, amperes
- — operating temperature range; differential
- Type
- — manual, automatic
- — single stage, two-stage
- — line, low voltage with transformer and relays
- — surface, flush mounting

☐ **Installation**
- — mounting dimensions
- — special circuiting or control
- — detail drawings
- — equipment schedule

☐ **Other items** pertinent to system design

9.1 Ventilation and air conditioning

Ventilation and air-conditioning equipment is available in a wide selection of packaged, easily-installed forms. Choice of equipment is extensive, ranging from air movement only to the fields of controlled humidity, temperature, motion and the removal of dust, gases or bacteria from the atmosphere. Air movement only satisfies the requisites of ventilation, with fans and exhaust units available for supplying or removing air to or from enclosed space by either natural or mechanical means. Complete air conditioning units are of course more comprehensive in their equipment and control.

In most instances, the installation of unit air-control apparatus combines the mechanical problems of locating and attaching the equipment with the electrical problems of wiring and control. Substantially, this covers the same scope and involves much the same techniques used to install most types of electrical equipment.

Where close control and exact capacities are not critical, savings can be achieved by specifying factory-assembled units combining air handling with condensing equipment in a single cabinet, balancing the capacities of coil and condenser. These combination units widen the compromise between actual load and rated capacities of the conditioners, but units of ½-, 1½-, 3-, 5-, 7½-, 10- and 15-ton refrigeration capacity are proving economical in many iocations.

Vibration dampeners of either felt, sponge or rubber-in-shear should be specified to isolate and minimize the transmission of sound or motor motion. Floor and beam loadings should be checked before installing conditioners, for suspended units can add up to 100-lbs/sq ft, and self-contained units can double that figure.

Wiring should be sufficiently heavy to minimize voltage drop, for this has a definite effect on equipment life through slower starting. A separate circuit should be specified for an air conditioning unit. Such a circuit should be No. 12 wire or larger, with flexible conduit used for motor connections to prevent sound and vibration transmission.

To avoid confusion with conventional light switches, control switches for air control equipment should be clearly marked and/or mounted at least 12 ins. above customary light switch height.

9.12 Ventilation equipment

Specifications for this type of equipment should cover the following important points:

9.121 Type

Fan or blower equipment; who is to furnish it—others or the electrical contractor.

9.122 Ventilating characteristics

Diameter of fan in inches; number and type of blades; air handling capacity in cubic feet per minute (cfm); details on fan housing, guards, exterior shutters, etc.; type of motor drive (direct, belt-connected, etc.).

9.123 Electrical characteristics

Motor hp, voltage, phase, frequency, dc or ac, speed (single, or multi), full load motor amperes, manual or automatic control.

9.124 Motor control

Type of control (manual, automatic); ampere and volts rating, number of poles, constant or multi-speed; necessary motor protective devices.

9.125 Installation instructions

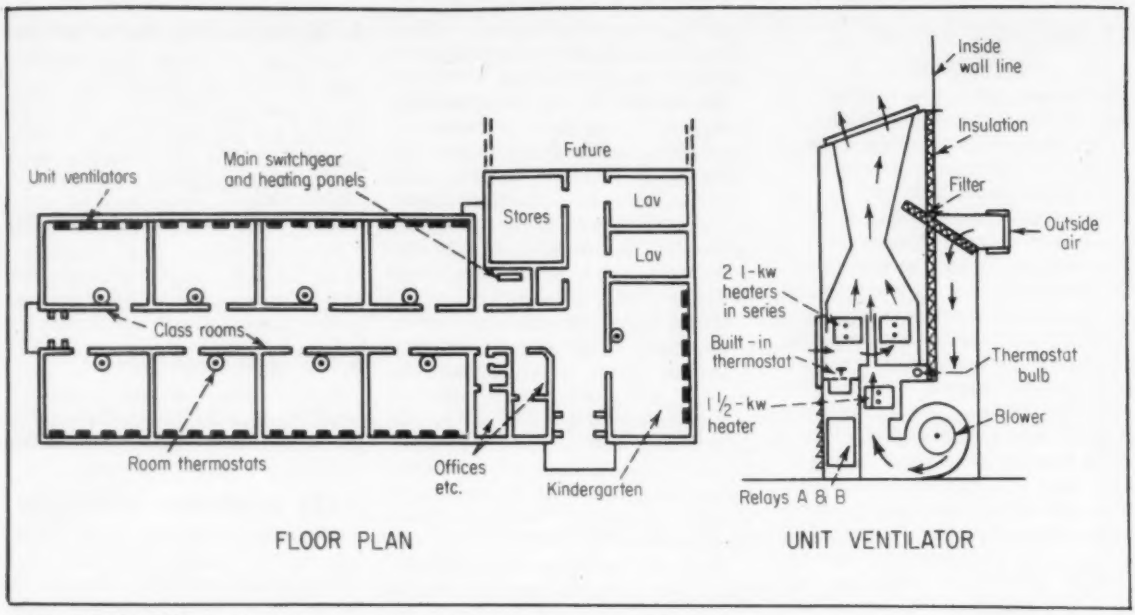
Mounting, fastening, support details; special guards, enclosures, etc.; special control circuiting. Furnish detail drawings where considered necessary.

9.126 Typical fan specification

In the opening provided by others, furnish and install a propeller fan to have a capacity of —— cu ft of air per minute, at a speed not exceeding —— rpm, and with a decibel rating not to exceed ——. The fan wheel shall be dynamically balanced and mounted directly on the motor shaft. The motor shall be dynamically balanced and provided with —— bear-

UNIT SIZE HP	VOLTAGE RATINGS AVAILABLE															
	60 Cycle									50 Cycle						
	1-Phase			2-Phase		3-Phase				1-Phase			3-Phase			
	115	208	230	220	440	208	220	440	550	100	200	230	208	220	380	440
1/3	X									X						
1/2	X	X	X							X	X					
3/4	X	X	X							X	X					
1		X	X								X	X				
1 1/2		X	X													
2			X	X	X	X	X	X	X						X	X
3			X	X	X	X	X	X	X				X	X	X	X
5				X	X	X	X	X	X				X	X	X	X
7 1/2			X			X	X	X	X				X	X	X	X

REFERENCE CHART for unit type air conditioners shows available voltage, phase and frequency ratings of various size units.



UNIT VENTILATORS in school classrooms have 3½ kw of electric heating in each unit; are located as indicated on plans.

ings. The complete fan, including the motor, is to be guaranteed as a unit by the manufacturer.

On the exterior, furnish and install a shutter (motor operated, manually operated, automatic) of the following size and type ——.

Fan shall be provided with a screen guard of the appropriate size and type. Control shall be provided by means of a switch installed where shown and of the following type and characteristics (state size, catalog number, rating, number of speeds, surface or flush).

9.127 Unit ventilator specification

A specification for unit ventilating equipment (for school classrooms) might read as follows:

Furnish and install, in accordance with manufacturer's instructions, —— Company, Type ——, Model No. ——, or approved equal, electric unit ventilators of capacities as indicated on the plans. Air delivery of the unit shall be based on the ASHAE Standard Code for Testing and Rating Unit Ventilators.

The unit shall be complete with: fans direct-connected to a —— speed, —— hp, —— volt, —— phase motor; motor control switches; (number) —— watt, —— volt electric heating elements to heat incoming air; one room and one outdoor air damper; a one-piece (trade name) renewable air filter in a permanent hinged frame, to filter both outdoor and room air.

Individual heating elements shall be of the tubular, finned metal sheath type with a high quality coiled resistor wire embedded in the refractory material in the sheath. Individual elements shall be mounted on suitable metal frame to form heating section. Automatic reset, snap-action type thermal protection shall be furnished on each heating element to protect the element in case fan motor fails or is turned off.

Unit assembly shall be enclosed in a —— gauge, welded sheet metal console cabinet with removable front cover section. Unit shall have bonderized smooth baked enamel finish and a laminated plastic surfacing material on the top of the cabinet. Color shall be as specified by the architect.

Unit shall be furnished complete with suitable connection and terminal strip boxes for all electrical connections and shall be arranged for thermostatic control.

Where other accessories such as germicidal lamps for sanitizing air, visual signal filter indicators (to signal when filters need changing), or other devices are desired, add pertinent specification clauses to the equipment descriptive specifications.

9.13 Air conditioning

Specifications should include the following important data:

9.131 Type of equipment

Window unit, console unit, self-contained commercial units, central units, reverse-cycle heat pump, unit ventilator with cooling system, etc.

9.132 Performance characteristics

Refrigeration capacity in tons; Btu per hour heat removal; dehumidification capacity (Pts. per hour); air circulation capacity (cfm); single or multi-stage (heat-pumps, etc.) compressors; type of refrigerant; information on duct work (central systems); type of control; condenser cooling; number and type of filters (removable, etc.); other pertinent data.

9.133 Electrical characteristics

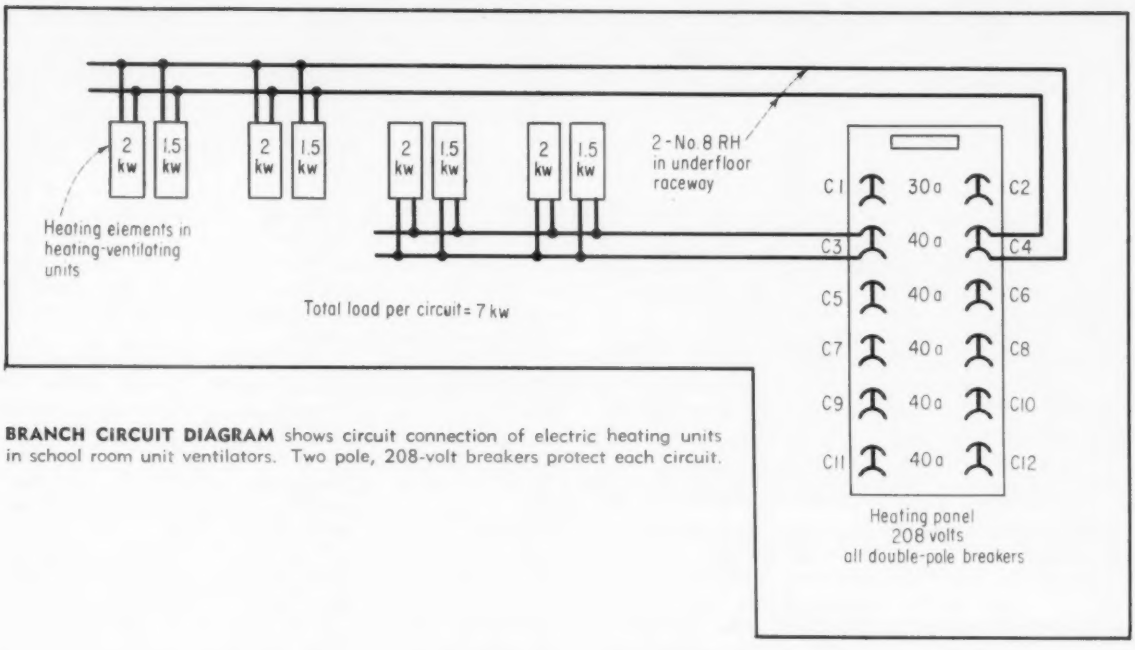
Number, size (hp), voltage, phase, frequency, speed and full load ampere ratings of motors involved in unit or system (compressor motors, fan motors, pump motors, etc); wattage rating of any supplementary electric heating units (for heating cycle) incorporated in the equipment assembly. This is vitally important data since circuits must be designed and specified on the basis of these electrical loads.

9.134 Control equipment

Type of electrical control units (manual, automatic, thermostatic, etc.); ampere and volts rating; number of poles; motor protective devices; constant or multi-speed; multi-step, etc.

9.135 Installation instructions

Mounting, fastening, support details; connection to separate supply circuits; special control circuiting; assembly of accessory devices; location of controls; provision for water piping; distribution air ducts and other pertinent informa-



BRANCH CIRCUIT DIAGRAM shows circuit connection of electric heating units in school room unit ventilators. Two pole, 208-volt breakers protect each circuit.

tion. Furnish detail drawings where necessary to insure proper installation.

9.136 Unit conditioner specification

The electrical contractor shall (furnish) (install) connect unit air conditioners as noted on the plans. No other electrical load shall be connected to circuits serving the air conditioning units. Room units shall be rated at —— volts, —— phase, (ac or dc), —— cycles. Compressor motor shall be —— hp. Unit shall be rated at —— Btu per hour; have a full load operating current of ——amps at the voltage noted; a wattage rating of —— watts (ASRE). Supplementary electric heating units (if included in assembly) shall be rated —— watts. Air circulation capacity shall be —— cu ft per minute. Refrigerant shall be ——. Condenser used in refrigeration cycle shall be cooled by ——.

Distribution ducts for cooled air shall be installed as shown on the plans; a separate duct for discharge of condenser heat to outdoors shall be coupled to the unit's housing and carried through wall as indicated on the plans.

Suitable specifications relating to the electrical work involved in central air conditioning systems can be developed covering the various data mentioned earlier in this discussion.

9.2 Electric Heating

Electric heating has been used for many years by industry for such production processes as induction heat treating of metals, infra-red baking of painted and enameled surfaces, etc. Specifications for such applications can be developed quite easily based upon the specific production process involved and will not be discussed here in detail.

More recently, application of electric energy to space heating has become more prevalent—both as supplementary heating with conventional systems and as complete heating system by itself.

Basic types of electric space heating include:

1. Radiant—where radiant energy of various wave lengths is transmitted directly from a heated surface to instantly warm a person or object within a direct line range.

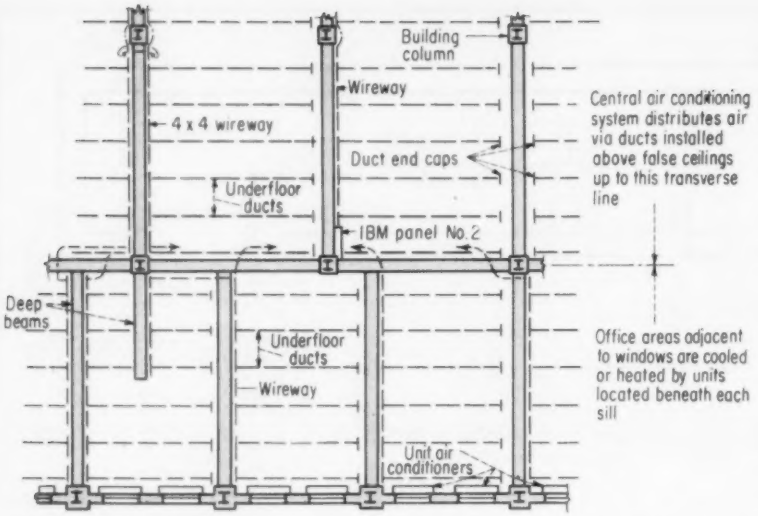
2. Convection—where a natural upward flow of heated air results from contact with a surface (a convector) heated by electric current.

3. Radiant and Convection—a combination of direct radiant energy from an electric heating unit and a natural upward flow of convected air resulting from difference in density.

4. Forced Air Flow—units where a fan forces air over an electric heating

ELECTRIC HEATING EQUIPMENT SCHEDULE

Plan Symbol	Location	Quantity	Type and Description	Unit Length	Unit Watts	Volts	Btu Output	Control	Remarks
A	Office	10	(Name, Cat. No.___, baseboard	8-ft.	1250	240	4265	Thermostat	
B	Private Office	4	(Name, Cat. No.___, wall panels		1500	240	5118	Thermostat	
C	Washrooms	2	(Name, Cat. No.___, wall units with fan		2000	240	6824	Thermostat and switch	



UNIT AIR CONDITIONERS under windows are combined with central air conditioning system to cool office areas in this building.

element and directs it through a housing or duct into the area to be heated.

Various electric heating units are currently available to provide any of the above types of space heating. Choice of system and specific equipment is the responsibility of the system design engineer. Factors influencing his selection may include: size and type of area to be heated; amount and type of thermal insulation in surrounding walls, ceilings and floors; amount and type of exterior glass and non-insulated wall areas contributing to heat loss; maintenance and economic considerations.

Components of the selected system should be specified in clear, concise terms. Emphasis should be placed on type and size of unit, exact location and specific control equipment.

Where a number of different types of units are involved in a project, the addition of an Electric Heating Equipment Schedule (similar to the conventional lighting fixture schedule) is recommended. This can be noted on the plans or in the written specifications. Typical column headings could read (from left to right): Plan Symbol; Location; Quantity; Type and Description; Unit Length; Unit Watts; Volts; Btu Output; Control; Remarks. Such a schedule would present a complete list of all electric heating equipment for the project and facilitate estimating, procurement and installation.

Specifications for electric heating equipment should include the following pertinent information:

9.21 Type of unit

Baseboard perimeter heating—a convection-radiation type of unit; specify length, wattage, voltage, Btu/hr, single or two-heat type.

Wall panel—radiant type; or convection type, natural or forced (with fan). Specify wattage, voltage, Btu/hr.

Floor unit—flush mounted in floors, normally under floor-to-ceiling windows to provide an effective warm-air "wall". Units are convection type. Specify Btu/hr, wattage, voltage.

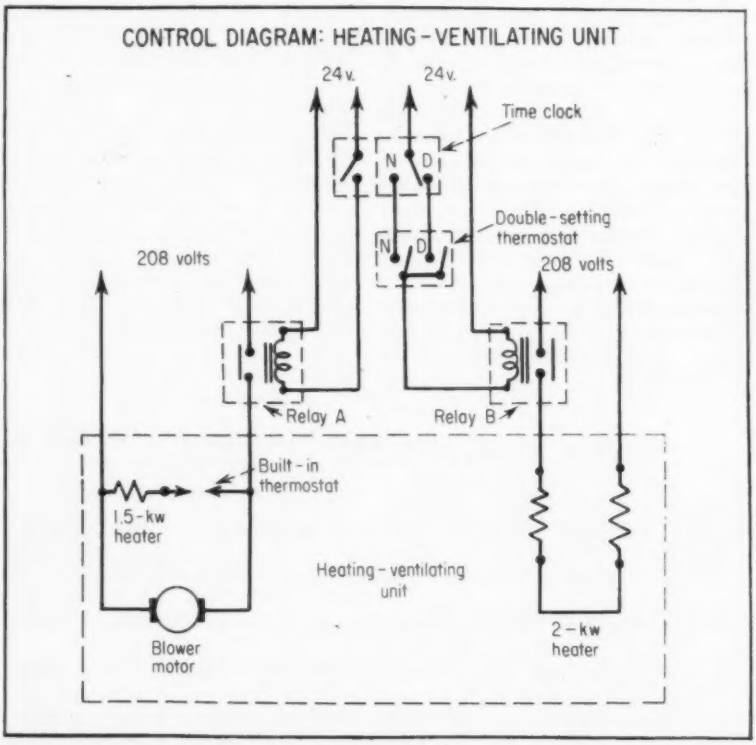
Glass panels, ceramic panels, asbestos panels—providing radiant heat energy; for wall or ceiling installation. Specify size, Btu/hr, wattage, voltage.

Heating cable—for ceiling (or concrete floor) installation to provide radiant type heating. Specify Btu/hr, maximum length in feet; color coding; wattage and voltage. Manufacturer's installation instructions should be followed.

Heat pump—for use with a forced-air duct system. Specify whether one or two-stage type; Btu heating capacity (with and without auxiliary heating units); wattage and voltage of auxiliary heating units; number, hp, volts, phase, amperes of compressor and fan motors; total kilowatt input.

Duct heaters—resistance heaters installed in air ducts for auxiliary heating. Specify Btu/hr, voltage, phase, wattage, physical dimensions.

Any or all of the above types of electric space heating units can be easily identified by manufacturer's name and model or catalog number, or approved equal, to incorporate the various specification points noted above.



LOW VOLTAGE CONTROL diagram of electric heating units and blower motor in unit ventilator assembly used in classroom, simplifies control connections.

9.22 Controls

Automatic control equipment (thermostats, etc.) must be matched to type of heating system and the desired degree of response to temperature change. Specifications should clearly state if control is to be a single-stage or dual-stage; frequent cycling (to maintain constant room temperature when using quick-heating, quick-cooling panels); slower cycling (for use with slow-heating, slow-cooling floor or ceiling cable and panels); line voltage, or low-voltage controls with transformers and relays.

Indicate number of heating units per control (individual unit or area control); non-inductive rating—amperes, volts; temperature range in degrees F; temperature differential; type of mounting (surface, flush) and type of finish. Also additional features desired, such as: external manual switch with marked positions; locking cover, etc. Preferred method of specifying such controls is by manufacturer's name, model number and/or catalog number for item containing desired features. Descriptive clauses may be added, if considered necessary.

9.23 Installation instructions

Any special instructions and details regarding mounting, fastening or supporting units; connection to supply circuits; control circuiting, special guards, enclosures, etc.; specific dimensional information for mounting units and/or controls; reference to relevant NEC regulations governing installation.

9.24 Heating specification

With slight modification, the following prototype specification for a baseboard electric heating installation can be adapted to other types of equipment.

The electrical contractor shall furnish and install electric space heating units as noted on the plans and listed in the Electric Heating Equipment Schedule. Installation shall be in strict conformance to NEC regulations for this type of equipment.

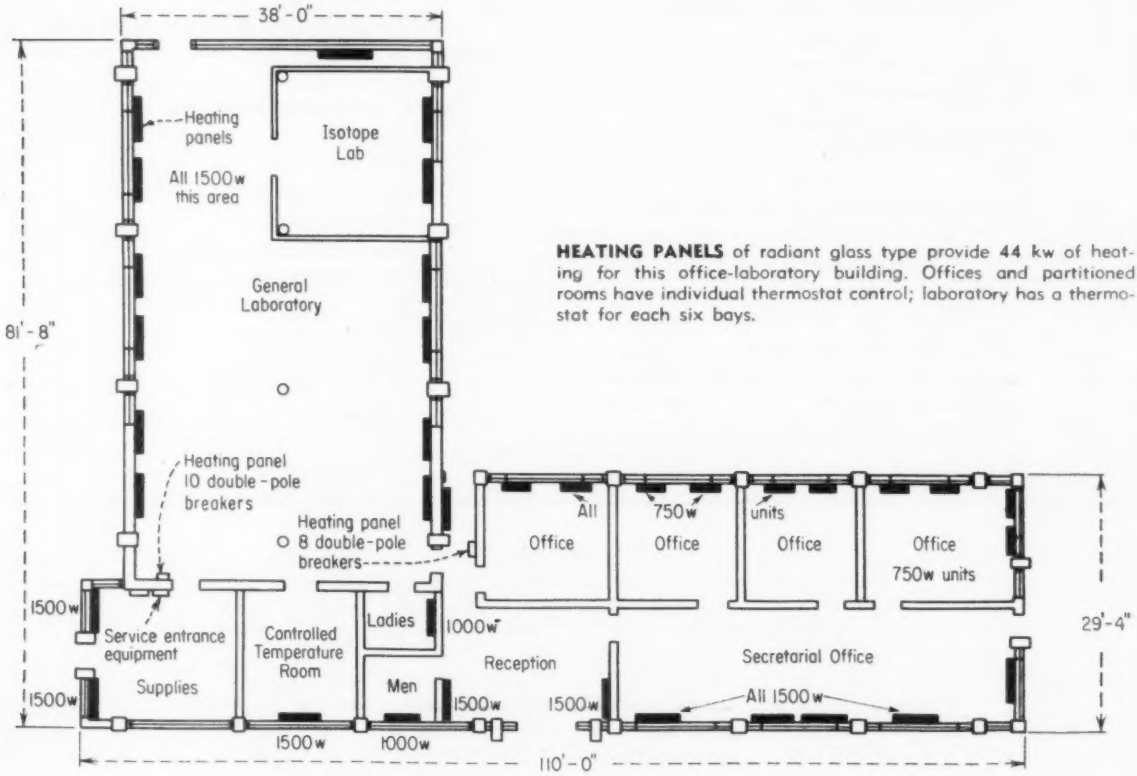
Separate circuits of sizes and type indicated shall be installed as shown on the plans. Connections from branch circuit outlets to heater unit raceway or junction box shall be made with (armored cable, flexible conduit and wire).

Heating units shall be ——— Company, (trade name), **or approved equal, baseboard type of single-heat (two-heat) construction as noted on the Schedule, for operation on a ——volt, —— phase, —— wire distribution system. Specified catalog numbers indicate heater length, Btu/hr output, wattage and voltage of individual units. Equipment shall be supplied complete with required blank sections, corner and trim accessories to provide an uninterrupted perimeter installation as shown on the plans. Units shall be (surface) (semi-recessed) mounted — in. above floor level.**

The complete system shall be automatically controlled by thermostats located — ft above floor level where shown on the plans. Thermostats shall be ——— Company, Model No. ——, Catalog No. ——, or approved equal. Units shall be line voltage (low voltage), single-stage (two-stage) type rated —— watts, —— volts. Temperature range shall be —° F to —° F, with a rated differential of approximately — ° F. Units shall be for surface (flush) mounting as indicated and covers shall have a —— finish.

Where additional control equipment accessories are required, include suitable specification paragraphs covering same.

For heating cable, standard cable lengths should be specified and manufacturer's instructions followed. Cable lengths must not be altered.



HEATING PANELS of radiant glass type provide 44 kw of heating for this office-laboratory building. Offices and partitioned rooms have individual thermostat control; laboratory has a thermostat for each six bays.

10.0 Residential Wiring

- ☐ **Codes** — NEC, local, etc.
- ☐ **Contracts** — with owner, developer, builder
- ☐ **Permits, fees** — secured and paid by whom
- ☐ **Temporary Power** — who shall furnish and use facilities; who pays for energy consumed
- ☐ **Service Entrance** — volts, amps, phase, wire
  - — Underground (direct burial, in duct)
    - — conductors — size, insulation type, single conductor or cable assembly
    - — ducts — metal, fiber, Transite, etc.
  - — Overhead (single conductors, cable assembly)
    - — conductor size, type insulation, type of cable (SE), (ASE), etc.
  - — Location — check local utility rules
- ☐ **Service Switch and Panel** — size of mains volts, amps, phase
  - — number and size of branches
  - — switches and fuses
  - — circuit breakers
- ☐ **Load Centers** — same information as for panels above
- ☐ **Branch Circuit Wiring** (check local codes)
  - — knob and tube
  - — non-metallic sheath cable
  - — armored cable
  - — flexible conduit and wire
  - — EMT and wire
  - — rigid conduit and wire
- ☐ **Branch Circuits** — number and type
  - — lighting
  - — general purpose
  - — fixed appliance
  - — multi-wire appliance
  - — full circuit appliance
  - — special purpose (outdoor lighting, receptacles, etc.)
- ☐ **Wiring Devices** — rating and type and color of each

Switches — No. of poles, 3-way, 4-way, standard, silent operation
- — push type, tumbler, rotary, illuminated
- — master, time, door, special purpose
- — dimmer control for lighting

Receptacles—rating, type and color of each
- — single, duplex, triplex
- — split circuit, switched
- — standard grounding type
- — combination 125-, 250-volt grounding type
- — special purpose appliance type

Plates—metal or composition, switch or receptacle, color and finish, weatherproof

- ☐ **Low Voltage Remote Control System** — No. of switches relays, master stations, No. of devices controlled
- ☐ **Air Conditioning** — type (central, room units), capacity, electrical rating (amps, volts, phase)
- ☐ **Electric Heating** — type of units, rating (amps, volts), No. of control thermostats.
- ☐ **Exhaust Fans** — type, capacity, electrical rating for kitchen, bath, attic, etc.
- ☐ **Signal and Communications**
  - — telephone
  - — intercom system
  - — fire alarm system
  - — TV antenna system
  - — high fidelity sound system
- ☐ **Lighting Fixtures** — type and wattage of each
  - — to be furnished by . . . . . .
  - — to be installed by . . . . . .
  - — types as indicated on fixture schedule
- ☐ **Other items** as required by specific project

The following design considerations and specifications are those particularly applicable to the wiring of residences and multiple occupancy dwellings in which provisions must be made for modern household appliances.

House wiring in design and function is unique among the construction features and services in the home. Other features like roofing or heating are permanent and fully integrated. Their uses will not change significantly during the life of the house even though their parts may be repaired, altered or replaced. Wiring, however, must serve not only the apparent loads at the time of construction, but many more loads which will appear as the occupants acquire appliances. Some of these loads are predictable, some are unknown. Special consideration must be given to installations of electric heating and central air conditioning or both.

The home buyer invariably expects that the wiring system of a new home will accept and operate efficiently any

or all of the electrical appliances currently advertised that he can afford.

The code permits a minimum of No. 6 conductors for the service entrance to a single family dwelling. Most practical installations in even the smallest home will require larger conductors.

Planning the service entrance to a new home is one of the most important aspects of wiring system design. It is a major segment of the system cost and contains a substantial percentage of the copper requirements. The service capacity must be projected well beyond immediate requirements, or the owner is saddled with an expensive and wasteful replacement job as he purchases new appliances.

Contrary to popular belief, the design of residential services and feeders is more complicated than for many larger projects. Individual residential loads are highly variable in total demand from hour to hour, day to day and by seasons. Demand grows with the individual purchase of new appliances and with the decisive trend to increasing numbers of residential lighting fixtures.

A method of computing service entrance capacity is given in Article 220 of the National Electrical Code. It, however, is based on safety and may not be entirely adequate from the actual performance standpoint.

The code method follows:

1. Square feet of floor area times 3 watts per-square-foot gives the design lighting load.
2. Add 1500 watts of miscellaneous appliance load.
3. Take 3,000 watts at 100%.
4. Add 35% of the remainder.
5. This is the design lighting and small appliance load.
6. For an electric range (not over 12-kw rating) add 8,000 watts.
7. Add all fixed appliances.
8. Take 75% of the total fixed appliances, if there are four or more, and add to the range, lighting and small appliance totals.
9. Divide the total by the line voltage to obtain the minimum ampere capacity for the service conductors.

As a general consideration, a well designed wiring system should operate without interruption on any probable combination of loads. Overcurrent protection should not operate to limit the reasonable use of approved equipment in satisfactory working condition. On accidental overloads, or on equipment or cord failures, the resulting interruption should be limited in extent. For instance, failure of an iron cord should not shut down the food freezer or stop the washing machine.

Adequate branch circuit capacity is one of the least expensive conveniences which can be designed into the wiring system. In practical systems it requires only a few additional panel circuits or an additional load center panel plus a few feet of additional home runs. With proper layout little more cable or wire is required. For example, a strategically located panel may serve several full circuit outlets with no more cable than would be required to loop one circuit between them. The resulting benefit of adequate branch circuit capacity is to double or triple the effective trouble-free utility of the wiring system.

Practical circuit modifications and other suggestions for increasing the utility and efficiency of residential wiring systems will be covered throughout this section.

10.1 Service

Furnish and install the following service entrance where shown on the plans (check with local utility regulations regarding exact location).

Service entrance conductors shall be —— No. —— with Type —— insulation (R, RW, T, RH, etc.) with a total capacity of —— amps.

Service entrance conductors shall be:

- **(a) Service entrance cable (SE)**
- **(b) Armored service entrance cable (ASE)**
- **(c) Installed in —— in. conduit**
- **(d) Underground service entrance cable (USE) in accordance with the rules and requirements of applicable codes and the rules of the utility company serving the property.**

10.11 Underground

From a point on the utility pole 4 ins. above the upper conductor of the distribution lines, adding 30 ins. for drip loops and connections, provide a USE cable of the size specified to the service terminals of the service switch (meter box, service panel, etc.). Check local utility regulations.

From a point on the pole 8 ft above grade provide a run of —— in. rigid conduit down below grade with an elbow terminating at the level of the underground run. Provide insulating bushings at each end of the protective conduit run. The conduit shall be firmly attached to the pole with at least two approved supports.

Cable for the run up the pole shall be neatly coiled above the protective conduit for utility connection. The utility will install the coiled cable on the pole with protective wood molding, seal the upper entrance to the conduit, and make final connection to the distribution conductors.

a. Cable shall be buried to a depth of 30 ins. (or below frost line). Where cable passes under driveways it shall be covered by 6- by 2-in. creosoted wood planking to a distance of 3 ft beyond each side of the driveway.

At the building end of the underground run the cable shall be enclosed in a rigid conduit to a distance of 5 ft from the walls.

Where the cable enters the conduit, at each end of the underground run, the conduit shall be sealed with oakum and sealing compound. The seals shall be surrounded by 6 ins. of sand in all directions before back filling.

b. Extend the service conductor in rigid conduit underground at a depth of —— ins.

c. Extend the service conductor in approved (fiber, Transite, etc.) conduit underground from the pole to the building.

10.2 Panels and Switches

Panelboards and entrance switches are usually chosen from among the many specially designed for residential service. The main switch and branch circuits may be enclosed in the same box. Some types take advantage of the "six circuit rule" and parallel the main, range and dryer units.

The code permits up to six circuits to be served directly from the service entrance conductors. Multiple mains can be conveniently arranged to serve heavy duty appliance circuits, such as the range, dryer and water heater, and feeders to branch circuit distribution panels.

Branch circuit distribution may be incorporated in the service entrance panel enclosure, or in separate panels located at load centers and served by feeders from one or more of the mains.

Typical equipments provide for up to six double-pole fused switches or circuit breakers (or 12 single poles operable by six handles) on a main bus. A separate bus with a group of branch circuits in the same enclosure is fed from one of the mains.

Most residential wiring systems use a single panelboard. There is a trend, however, toward dividing the circuits among one or more additional load center panels which can be located

advantageously near load concentrations.

When power centers are located flush in living areas it is important that provisions be made for access to the spares for future use. A 1-in. empty conduit, tubing or flex is extended to the basement or attic terminating in a 4-11/16-in. box with blank cover.

The main service switch or panel must be located within 3 ft of the entrance of the service conductors. Additional panels may be located wherever convenience may indicate.

10.21 Service switch

Where required, furnish and install at location noted on plans a (fused, or circuit breaker) main entrance switch rated —— amp, —— volt, —— pole, with neutral bus. Switch shall be approved for use on service entrance equipment, and shall be Type —— as manufactured by the —— Company, or approved equal.

If no separate main entrance switch is required, see specification clause for main panel below.

10.22 Main panel

Furnish and install where noted on the plans a (manufacturer's name), Type ——, or approved equal, service entrance panel with —— amp mains and the following circuits: (List size and type of circuits and describe connection of main disconnects, if more than one).

Panel shall be dead front type for (surface, flush) mounting with circuit overcurrent protection provided by:

a. fuses

b. circuit breakers (thermal, thermal magnetic, etc.)

When used as a service entrance, the main panel shall be approved for use as service entrance equipment.

From the entrance panel provide (number) feeder(s) of —— No. —— Type —— conductors (specify cable or type of raceway to be used) to the mains of the load center(s) as indicated.

10.23 Load centers

Where indicated on the plans, furnish and install (manufacturer's name), Type ——, or approved equal, load centers for (surface, flush) mounting as indicated. Units shall be of size (number and ampere rating of branch circuits and mains) and type (fuse, circuit breaker) as noted.

10.3 Wiring System

In single-family residences the method of wiring is usually determined by local ordinances or historical practice in the community. For multi-family dwellings, flats, and apartment houses, the wiring system employed usually follows commercial and institutional practice. The following specification is intended to apply to single-family dwellings or multi-family dwellings of similar construction and electrical consideration.

The six wiring systems most widely used in residential work are:

Knob and tube
Non-metallic sheath cable
Armored cable
Flexible conduit and wire
EMT and wire
Rigid conduit and wire

Combinations of methods are sometimes used: rigid conduit service and cable branch circuits or EMT on exposed work and armored cable concealed. All are approved by the National Electrical Code. Local ordinances in some communities may omit or restrict the use of some.

Wiring shall be —— (specify wiring system) installed in accordance with the installation rules of the National Electrical Code and local rules and ordinances which apply. Wiring shall be installed firm and true, in an expert manner mechanically and electrically. Cutting and drilling of structural members shall be limited to that essential for proper installation.

Grounding conductor (on knob and tube or non-metallic sheath cable systems). Circuits or cables serving grounding type receptacles shall contain a grounding conductor firmly connected at the outlet to the box (if metal) or to the grounding terminal of the device.

10.31 Outlet boxes

Outlet boxes shall be of steel (non-metallic) type as manufactured by —— Company, or approved equal. Boxes shall be of the proper size and type for the fixture or device accommodated. Outlet boxes shall be fastened firmly in place with hangers, brackets, or other methods particularly designed and approved for the purpose.

Outlet boxes shall be (a) knockout type with separate cable clamps or connectors (locknuts and bushings, etc.), (b) equipped with integral cable clamps or connectors. Unused knockouts shall be left in place or provided with an approved closure.

Locknuts or connectors shall be set up tight to provide a firm mechanical and electrical connection.

Unless otherwise indicated, the following outlet boxes shall be used:

Ceiling Fixtures—4-in. octagonal 1½-in. deep.

Bracket Fixtures—4-in. octagonal 1½-in. deep with 2¾-in. round ¾-in. deep plaster cover.

Wiring Devices—Rectangular switch box, 3-in. deep ganged as required.

Where ceiling, bracket or device outlets serve as junction boxes or contain more than six (exclusive of fixture wires) conductors, they shall be 4-in. square 1½-in. deep with ¾-in. plaster cover appropriate for the fixture or devices.

Outlet boxes for flush devices on 30- or 50-amp circuits shall be 4-11/16 square 2⅛-in. deep with appropriate cover.

10.32 Surface wiring

Where wiring is run exposed in basement, garage and attic space, surface type wiring devices shall be used. Devices shall be mounted firmly as recommended by the manufacturer and wiring securely installed. Cable shall be independently fastened in place within 6 ins. of terminal connections.

Surface devices, raceway installation. When wiring is run exposed as in basement, garage and attic space, outlets, boxes and devices shall be suitable for exposed work and shall present a neat and workmanlike appearance.

a. Boxes shall be pressed steel type with rounded corners and fitted covers designed for the device installed. Raceways (rigid conduit, EMT) shall be installed square.

b. Raceways shall be surface type steel raceways (manufacturer's name), No. ——, or approved equal, installed square with elbows, boxes, connectors and closures designed specifically for use with the raceway and of the same manufacture.

10.4 Branch Circuits

In addition to adequate service entrance capacity, the number and type of branch circuits installed in a residence establish the utility of the electrical system and electrical convenience of the home. Beyond normal lighting and receptacle facilities, the following circuits permit safe and efficient use of appliances and should be considered when specifying a residential wiring system. Many of these are covered in subsequent typical specification clauses in bold face type.

a. Multiwire appliance circuits: Kitchen and dining areas need at least two 20-amp circuits to handle simultaneous operation of groups of high

BRANCH CIRCUIT SCHEDULE

Typical branch circuit schedule for a 1500 sq ft residence with conventional electrical appliances.

Full Circuits

Electric sink	1—20-amp
Automatic washer	1—20-amp
Ironer	1—20-amp
Air conditioner (room type)	2—20-amp
Hobby bench	1—20-amp

Heavy Duty Circuits

Range	2—50-amp
Water heater	2—20-amp
Dryer	2—30-amp

Isolating Circuit

Ref,; Freezer; Oil Burner	1—20-amp

Appliance Circuits

Small appliances	3—15-amp

Lighting Circuits

1500 sq ft	3—15-amp

wattage appliances (toaster, grille, coffee maker, etc.). A 3-wire, common neutral circuit with each plug receptacle on alternate sides of the circuit gives some assurance against overloading.

b. Full circuits to fixed appliances: Modern automatic appliances in portions of their operating cycles often require currents near full circuit capacity. It is good practice to provide individual circuits to such typical appliances as:

Dishwasher—disposal unit
Automatic washer
Room air conditioner
Ironer
Bathroom or nursery heater

c. Full circuit to appliance groups: Some types of automatic appliances do not offer individual loads near circuit capacity, but should be isolated as a group to assure uninterrupted operation. Included are the refrigerator, the food freezer and the heating plant. (Some local codes require an individual circuit to an automatic heating plant.) Separate circuits here avoid interruption as a result of overload or cord failures.

d. Load center panel: Economical circuiting for modern appliance loads usually requires the use of load center panels near appliance groupings.

e. Circuit protection: Many motor driven appliances take a momentary starting current which may exceed the rated circuit capacity. Under normal conditions these overloads are harmless and should not operate the overcurrent protection device. Circuits serving such appliances should be equipped with circuit breakers or time delay fuses.

Single-phase motors on electrical appliances operate at relatively low power factor and, in normal operation, may require considerably higher currents than that indicated by dividing rated watts by voltage. Check this when specifying circuit sizes.

Adapt any or all of the following specification clauses in developing branch circuit specifications for a specific residential layout.

10.41 Branch circuits—general

Furnish and install branch circuits from the panelboard(s) to the outlets as shown on the plans or described in the outlet or branch circuit schedule. Circuits shall be of the type and size as noted.

10.42 Lighting

Lighting and plug receptacle circuits in areas other than the kitchen, laundry utility room, basement or porch shall be 2-wire No. 14 (No. 12) 15-amp circuits. One circuit shall be provided for every 500 sq ft, or fraction thereof, of floor area. Circuiting shall be as indicated on the plans.

10.43 Appliance

Plug receptacles in the kitchen, laundry utility room, basement and porch, other than those on special circuits, shall be served by not less than two No. 12, 20-amp appliance circuits. A 3-wire circuit with individual receptacles connected alternately to either side is permitted.

10.44 Isolating

Plug receptacles for the refrigerator and freezer and the outlet for connecting the heating plant shall be served by a separate No. 12, 20-amp appliance circuit. (In some communities codes may require an individual circuit to the heating plant.)

10.45 Individual

Plug receptacles for connection of the following appliances shall be served by individual No. 12, 20-amp appliance circuits:

Automatic clothes washer
Electric dishwasher and disposal unit
Bathroom heater
Nursery heater
Room cooler
Attic fan
Hobby bench

The outlet for the electric clothes dryer shall be served by an individual 3-wire, No. 10 circuit terminating in an approved 30-amp, 3-wire flush (surface) receptacle.

The outlet for connecting the electric range shall be served by a 3-wire No. 6 circuit terminating in an approved flush (surface) 50-amp 3-wire receptacle.

The outlet for connecting the electric water heater shall be wired in accordance with the requirements of the local utility. (Local requirements vary depending upon metering provisions, permissible element capacities, etc. The utility rules should be consulted.)

10.46 Unit air conditioners

A special purpose outlet, located at the most likely point of installation, on a separate No. 12 circuit should be installed in each principal living area and in each bedroom for unit air conditioners.

The use of general purpose or appliance circuits to serve air conditioners is not recommended. Even smaller units, though they may be rated within the capacity of such circuits, require a large portion of the circuit capacity under continuous duty over long periods of time. During this time the entire circuit and its other outlets are effectively disabled and inaccessible for other uses for which the circuit is intended, designed and installed.

10.5 Wiring Devices

Furnish and install, where shown on the plans or noted in the outlet schedule, the wiring devices indicated. Flush devices shall be of the best quality (specify color). Plates shall be (composition, brass, etc.) and finished —— (specify color or finish). Where more than one device is indicated at a location, the devices shall be provided with one plate of the necessary size.

10.51 Outlet location

The plans indicate approximate outlet location. Exact location of all outlets shall be as directed by (architect, owner, etc.). Unless otherwise noted, wiring device outlets shall be installed as follows:

Convenience outlets; ——ins. above floor.

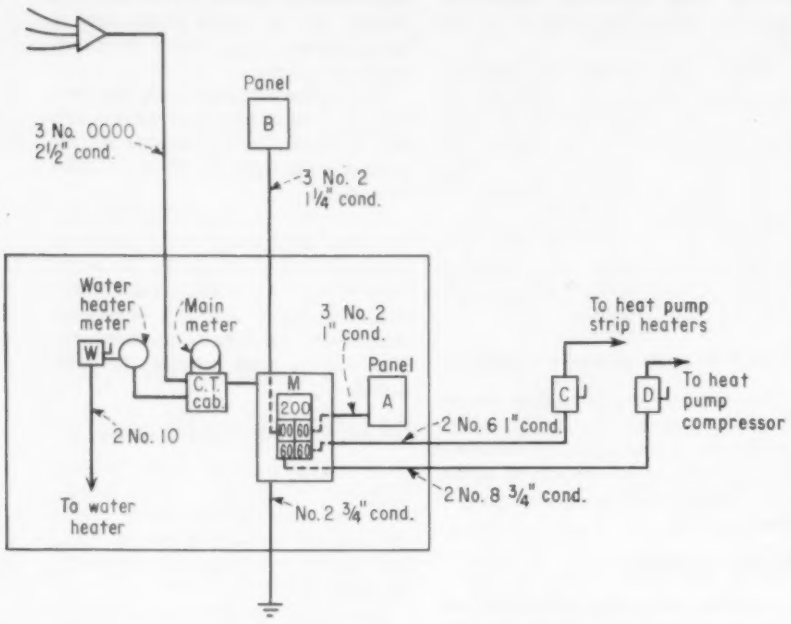
Appliance outlets; ——ins. above counters.

Switches; ——ins. above floor.

Telephone, TV, Hi-Fi; ——ins. above floor, or as directed.

Intercom; ——ins. above floor.

All other outlets; as noted.



Symbol	DESCRIPTION
M	Main Distribution Panel -200 amp 3-pole, S.N. 2 fuse Main Disconnect -1-100 amp 2 pole -3- 60 amp 2 pole
A	Panel "A" 8 - 15 amp S.P. 2 - 20 amp S.P. 1 - 30 amp 2 P.
B	Panel "B" 10 - 15 amp S.P. 4 - 20 amp S.P. 2 - 30 amp 2 P. 1 - 40 amp 2 P.
C	Heat pump switch - 60 amp 2-pole, 2 fuse
D	Heat pump switch - 60 amp 2-pole, 2-fuse
W	Water heater switch 30 amp, 2-pole, 2 fuse

RISER DIAGRAM of a home equipped for all-electric services. Separate circuits serve the heat pump-air conditioner and its auxiliary resistance heating coils. Lighting and appliances are served by two separate distribution panels.

10.52 Switches

a. Furnish and install at each switch outlet a quiet operating, specification grade switch, single-pole, 3-way or 4-way as indicated.

b. Furnish and install at each switch outlet a T rated tumbler type switch, single-pole, 3-way or 4-way as indicated.

c. Furnish and install at each switch outlet a rotary type, quiet operating switch.

Switches shall be provided with terminal screws, connectors or screwless terminals to accommodate up to No. 10 solid conductor.

10.53 Dimmer switches

Furnish and install where shown on the plans, dimmer controls as manufactured by the —— Company, No. ——, or approved equal. Controls shall be of the variable reactance type and shall be installed and connected in an approved manner according to manufacturer's instructions. Capacity of each dimmer shall be —— watts incandescent, —— watts R/S fluorescent.

10.55 Receptacles

Furnish and install at receptacle outlets on lighting circuits a (duplex, triplex) plug receptacle, 15-amp, 120-volt for parallel blade attachment caps.

Furnish and install at receptacle outlets on appliance circuits a grounding type duplex plug receptacle, 15-amp, 120-volt designed to handle either parallel blade or grounding type attachment caps.

At locations shown on plans furnish and install:

a. (for 115-volt air conditioners) a 15-amp 125-volt grounding type receptacle of the parallel blade type.

b. (for 230-volt air conditioners) a 15-amp 250-volt grounding type receptacle of the tandem blade type.

Each outlet for air conditioners shall be served by a separate No. 12, 2-wire circuit from the panelboard located as shown. Circuits shall be arranged to serve 115- or 230-volt equipments as shown on plans.

Receptacles and plates located outdoors shall be weatherproof type with —— type closure.

The receptacle contacts shall be designed to grip both sides of each blade. Terminal screws or connectors shall be designed to firmly terminate up to No. 10 solid conductors.

10.56 Multi-outlet assemblies

Multiple outlet assemblies shall be furnished and installed where shown on the plans or indicated in the outlet schedule. Each section shown shall be continuous with outlets spaced —— in. apart.

On lighting circuits the assembly shall be designed to take standard parallel blade attachment caps.

a. They shall be 2-wire type with switch control as shown or described on the outlet schedule.

b. They shall be the divided circuit type with upper positions switched as shown.

On appliance circuits the assembly shall be grounding type designed to take either standard parallel blade attachment caps or grounding type attachment caps on any outlet.

10.6 Relay Switching

Switch control of the outlets noted on the plans shall be provided by a low-voltage remote control system as manufactured by the —— Company, or approved equal. All wiring, relays, switches and components shall be designed for use with this system. (see Low Voltage Control (6.95) in Section 6.0—Branch Circuits for detailed specifications.)

10.7 Exhaust Fans

Kitchen: Furnish and install where shown on plans a kitchen exhaust fan Catalog No. —— as made by —— Company, or approved equal. Fan shall be designed to handle not less than —— cu ft of air per minute. External opening shall be provided with (specify type of louver, closure,

or vent). Fan shall be controlled by (specify type and location of switch).

Attic: Furnish and install where shown on plans an attic exhaust fan Catalog No. —— as made by —— Company, or approved equal. Fan shall be designed to handle not less than —— cu ft of air per minute. External opening shall be provided with (specify type of louver, closure, or vent. Fan shall be controlled by (specify type and location of switch).

10.8 Space Heating

Specifications for electric space heating should describe the type, capacity and location of each unit or group of units and the type and location of each thermostat and associated relay designating the units controlled. Heating equipment should be installed in accordance with Article 422, noting particularly 4271 through 4286, of the National Electrical Code.

See Section 9.0—Heating and Air Conditioning—for more detailed specification clauses covering electric space heating.

10.9 Signal and Communication Systems

10.91 Door chimes and signals

Furnish and install where indicated on the plans door chimes having —— notes, as manufactured by —— Company, No. ——, or approved equal. Chimes shall be for (recessed, surface) mounting and shall be complete with transformer, pushbuttons and components. Wire complete to button in door station plate.

10.92 Intercom systems

Furnish and install a complete —— station intercom system with master station located in the —— room and other stations located as noted on the plans. System shall be the —— Type, as manufactured by the —— Company, or approved equal. System shall be installed in accordance with manufacturer's instructions and left fully equipped and in first class operating condition. (For more detailed specifications see Section 11.0—Signal, Communications and Auxiliary Systems.)

10.93 Fire alarm system

Furnish and install a (trade name or catalog number) fire alarm system manufactured by the —— Company, or approved equal. Sensing units and alarm shall be located and installed as indicated on the plans. All wiring shall be in accordance with manufac-

Load and Circuit Values for Special-purpose circuits

Appliance	Typical Wattage	Circuit Conductors	Voltage	Circuit Protection	Note
Range	10,800	No. 6	120/240	50-amp 2p	
Oven (built-in)	4,500	No. 10	240	30-amp 2p	
Range top (2 unit)	3,000	No. 12	120/240	20-amp 2p	
Range top (4 unit)	6,000	No. 10	120/240	30-amp 2p	
Dishwasher	1,200	No. 12	120	20-amp 1p	
Refrigerator-freezer	600	No. 12	120	20-amp 1p	1
Dryer	5,000	No. 10	120/240	30-amp 2p	
Washer-dryer	5,000	No. 10	120/240	30-amp 2p	
Washer	1,200	No. 12	120	20-amp 1p	2
Ironer	1,600	No. 12	120	20-amp 1p	2
Water heater	3,000	No. 10	240	20-amp 2p	3
Air cond. ¾ hp	1,000	No. 12	120	20-amp 1p	
Air cond. 1½ hp	2,300	No. 12	240	20-amp 2p	
Air cond. (central)					
5 hp	6,500	No. 6	120/240	70-amp 2p	4
3 hp	4,000	No. 8	120/240	50-amp 2p	4
Heat pump					
5 hp	6,500	No. 6	120/240	70-amp 2p	4
Supplementary	10,000	No. 6	240	50-amp 2p	5
Heating plant	500	No. 12	120	20-amp 1p	6
Attic fan ½ hp	800	No. 12	120	20-amp 1p	
Water pump 1 hp	1,500	No. 12	240	20-amp 2p	
Sump pump	500	No. 12	120	20-amp 1p	
Bathroom heater	1,500	No. 12	120	20-amp 1p	
Electric space heat	15,000	(as required)			7

The above loads are representative of those which require individual circuits, or which are preferably served by individual circuits as explained by the following notes:

Note 1. Refrigerators and freezers may be served by outlets on an appliance circuit. It is recommended, however, that these appliances be served by a separate circuit with no other outlets. The purpose of this recommendation is to eliminate the probability of interrupting the operation of these appliances as a result of connecting faulty cords or portable appliances to the same circuit.

Note 2. The automatic washer or the ironer may be served by an outlet on an appliance circuit. Separate circuits are recommended, however, because at portions of the operating cycle such equipment often takes 50% or more of the full circuit capacity.

Note 3. Water heaters involving off-peak rates involve special circuits. Consult the utility for connections.

Note 4. Central air conditioning load and circuit requirements vary with the size and capacity of the plant. Typical residential plants are rated at 3 and 5 hp in compressor load and ½ hp in fan load. Wiring should be installed in accordance with the manufacturer's specifications.

Note 5. Heat pump load and circuit requirements vary with the size and capacity of the plant. Typical residential plants are rated at 3, 5 and 7½ hp in compressor load, ½ hp in fan load plus, in some instances, supplementary resistance heating. Wiring should be installed in accordance with the manufacturer's specifications.

Note 6. Many local ordinances require a separate circuit for the oil burner or heating plant. It is also advisable for the reasons given in Note 1 above.

Note 7. Electric heating load and circuit requirements vary with the heating design requirements. Fixed electric space heaters are conventionally connected on 240-volt, No. 12 or No. 10 branch circuits. The connected load should not exceed 80% of circuit capacity.

turer's recommendations and local regulations. System shall be tested in presence of (authorized personnel).

10.94 Television antenna system

Furnish and install a (trade name or catalog number) concealed television antenna wiring system for —— outlets, as manufactured by the —— Company, or approved equal. System shall be complete with multiple outlet coupler (for 2 or more outlets), TV plug-in wall outlets of proper type, and attic-mounted antenna (or combination roof mast holder and weatherproof lead-in entrance; or waterproof lead-in entrance).

Where outdoor roof antenna is indicated, the electrical contractor shall leave sufficient lead-in wire coiled on the roof for connection to the antenna. TV lead-in entrance shall be located at least 15 ft away from power entrance pole.

Wall plug-in outlets shall be installed as indicated on the plans (at least one stud distance away from accompanying power outlet to prevent interference pick-up). Where multiple outlets are to be provided, wall plate shall contain a balancing terminator resistor to assure a balanced circuit at all times.

TV lead-in wire shall be 300-ohm type of grade (——) or better and shall be kept a minimum of 12 ins. away from any metal surface by use of insulated TV wiring stand-offs.

Where wiring is to be enclosed in a raceway, non-metallic conduit or loom shall be used. Wire shall be run in continuous lengths free of any splices. Connect outlets when plates are installed.

10.95 Hi-Fi sound system

Furnish and install a (trade name or catalog number) high fidelity sound reproduction system as manufactured by the —— Company, or approved equal. Installation shall be as indicated on the plans and in accordance with manufacturer's recommendations. (See Section 11.0—Signal, Communications and Auxiliary Systems—for detailed specifications.)

11.0 Signal, Communications and Auxiliary Systems



- ☐ **Intercommunicating Telephone System**
  - — general
  - — operation
  - — equipment
  - — terminal strip cabinets
  - — power supply
  - — wiring
- ☐ **Sound System**
  - — general
  - — functions and facilities
  - — equipment
  - — wiring
- ☐ **Fire Alarm System**
  - — general
  - — operation
  - — equipment
  - — wiring
- ☐ **Paging System**
  - — general
  - — operation
  - — equipment
  - — terminal strip cabinets
  - — wiring
- ☐ **Clock System**
  - — general
  - — operation
  - — equipment
  - — power supply
  - — wiring
- ☐ **Program Signal System**
  - — general
  - — operation
  - — equipment
  - — power supply
  - — wiring
- ☐ **Nurses' Calling System**
  - — general
  - — operation
  - — equipment
  - — wiring
- ☐ **Television Antenna System**
  - — general
  - — equipment
  - — power supply
  - — wiring
- ☐ **Public Telephone System**
  - — general
  - — terminal strip cabinets

11.1 Intercommunicating Telephone Systems

A. Two station.

B. Master selective ringing and common talking.

C. Master selective ringing and common talking, program and signal control.

D. Selective ring and common talking.

E. Selective ring and selective talking.

F. Private exchange, manual board.

G. Private exchange, automatic switching.

H. Apartment selective ringing and common talking, vestibule to apartments, apartments to door-opener. (1) loudspeaking system, (2) non-loudspeaking system.

11.11 General

Furnish and install an (trade name and/or number) intercommunicating telephone system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first-class operating condition.

11.12 Operation

A. Two station system: At the two locations shown there shall be a telephone arranged so that one station may call and converse with the other. A pushbutton shall be provided with each unit. Pressing the button at one station shall ring the bell at the other station. Lifting the handphone (or receiver) completes the talking circuit.

B. Master selective ringing and common talking: In the main office where shown there shall be a master telephone with pushbuttons (or selector switch) to selectively call any outlying telephone. At other locations the telephone shall have a pushbutton to call the master station. The master station after being called by an outlying station may call another outlying station to complete a connection between the two remote points. Only one conversation at a time is required.

C. Master selective ringing and common talking, program and signal control: In the main office where shown, there shall be a master telephone with pushbuttons to selectively call any outlying telephone by sounding the same buzzer in classroom clocks and bells at other locations as are used in the program system. At all other locations, except in principal's office, the telephone shall be furnished without a pushbutton or audible signal. Lifting the receiver on any outlying telephone shall sound a buzzer at the master telephone which is silenced by lifting the master telephone's handset. The master station after being called by an outlying station may signal another outlying station by pushing its corresponding pushbutton. When this station answers, the handset at the master is replaced on its hook (unless a 3-way conversation is desired) and a switch on the master is thrown to silence its buzzer. When the conversation between the two outlying phones is completed, the buzzer in the master shall sound as a reminder that the buzzer switch shall be returned to its normal position. Only one conversation at a time is required; however, as many outlying phones as desired may be on the line at the same time by the master signaling the desired phone for a conference. It shall be possible at the master station to transfer the audible signals from one program circuit to another without disturbing the overall program setting or any of the wiring.

D. Selective ringing and common talking system: At each location shown, there shall be a telephone arranged for calling and conversing with any other telephone in the system. Each station shall be provided with pushbuttons (or selector switch) for selectively ringing any other station. Only one conversation at a time is required.

E. Selective ringing and selective talking system: At each location shown, there shall be a telephone arranged for calling and conversing with any other telephone in the system. Each station shall be provided with pushbuttons (or selector switch) for selectively ringing and selectively talking with any other station in the system. It shall be possible to use several telephones simultaneously for a conference provided that the call station is not pre-occupied.

F. Private exchange, manual switchboard system: In the switchboard operator's room, there shall be a common return, lamp signal type manual switchboard arranged to call and interconnect any telephone in the system. At other locations where shown, there shall be a telephone of the type designated by the symbol. The telephone operator may call and converse with any outlying station, and any outlying station may call and converse with the operator, or be connected through the switchboard so that two outlying telephones may converse. Removing the handphone (or receiver) on any outlying station will cause its associated lamp to light at the switchboard. Connection from one line to another may be made by inserting the plugs of the cross-connecting cords into the calling and called station line jacks. Operator listens and converses through a headset and breast-plate transmitter or handset, connecting into individual cross-connecting sets by means of listening and ringing keys. Each set of cross-connecting cords shall be provided with supervisory lamps to indicate completion of a conversation between two stations. A buzzer and silencing switch shall be provided as a night signal.

G. Private exchange, automatic switching system: In the machine room in basement there shall be a complete automatic exchange unit. This shall consist of an automatic relay (or step-by-step) switching unit, cable distribution rack, rectifiers, control panel and battery with rack. At other locations where shown there shall be an automatic dial type telephone of the type designated by symbol. The system shall enable any station in the system to call and converse with any other station without the assistance of an operator. Lifting a handphone (or a receiver) on the calling station and dialing the desired number shall automatically ring the called station. The talking circuit is completed when the handphone (or receiver) is lifted at the called station. A busy signal shall be audible in the handphone (or receiver) of the calling station when the called station lines are pre-occupied.

H. Apartment selective ringing and common talking system, vestibule to suites, suites to door-opener: In each tenant's suite, there shall be a telephone. A pushbutton shall be provided thereon to operate the door-opener at the main entrance. In the vestibule, there shall be a telephone and plate with pushbuttons and card-holders for every suite in the building. Pressing a pushbutton thereon will cause a bell or buzzer to ring in the corresponding suite telephone. Only one conversation is required at one time.

11.13 Equipment

Aa. Install at the two locations a handphone on cradle type desk (or flush or surface wall mounting with handphone or with watchcase receiver and built-in transmitter) telephone having mounted thereon a pushbutton for calling the other telephone on the system. (Provide desk unit with 6-ft flexible cable, terminal strip box and buzzer signal.)

Ba. Install in office where shown a master handphone on cradle desk (or flush or surface wall mounting with handphone or with watchcase receiver and built-in transmitter) telephone having mounted thereon—pushbuttons (or selector switch with—points) to call all outlying stations. At all other locations, install the type of telephone indicated by symbol, having mounted thereon one pushbutton (or selector switch with one point) to call master station. (Provide desk unit with 6-ft flexible cable, terminal strip box and buzzer signal).

Bb. Install in or near power supply a retardation coil and connect to telephone system.

Ca. Install in office where shown a master telephone with handset mounted on a signal control board, flush or surface wall mounting, having

SIGNAL SYSTEM CABLES

Rubber and Lead

No. 18—1/64" RL*				No. 18—1/32" RL				No. 16—1/64" RL*				No. 16—1/32" RL			
Over. Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size
0.56	0.243	4/64"	1"	0.69	0.377	4/64"	1¼"	0.61	0.292	4/64"	1"	0.73	0.416	4/64"	1¼"
0.70	0.385	4/64"	1¼"	0.90	0.636	5/64"	1½"	0.76	0.454	4/64"	1¼"	0.96	0.723	5/64"	1½"
0.82	0.528	4/64"	1¼"	1.05	0.864	5/64"	2"	0.92	0.665	5/64"	1½"	1.12	0.985	5/64"	2"
0.94	0.680	5/64"	1½"	1.17	1.076	5/64"	2"	1.02	0.817	5/64"	2"	1.28	1.288	6/64"	2"
1.03	0.833	5/64"	2"	1.32	1.367	6/64"	2½"	1.12	0.985	5/64"	2"	1.41	1.563	6/64"	2½"
1.10	0.950	5/64"	2"	1.41	1.563	6/64"	2½"	1.20	1.130	5/64"	2"	1.51	1.791	6/64"	2½"
1.21	1.147	5/64"	2"	1.55	1.885	6/64"	2½"	1.35	1.413	6/64"	2½"	1.66	2.168	6/64"	3"
1.29	1.304	6/64"	2"	1.61	2.035	6/64"	3"	1.40	1.539	6/64"	2½"	1.76	2.435	7/64"	3"
1.33	1.390	6/64"	2½"	1.68	2.199	6/64"	3"	1.46	1.673	6/64"	2½"	1.83	2.631	7/64"	3"
1.42	1.571	6/64"	2½"	1.82	2.592	7/64"	3"	1.55	1.885	6/64"	2½"	1.95	2.985	7/64"	3½"
1.54	1.885	6/64"	2½"	1.98	3.063	7/64"	3½"	1.69	2.246	6/64"	3"	2.12	3.526	7/64"	3½"
1.68	2.199	6/64"	3"	2.15	3.628	7/64"	3½"	1.86	2.717	7/64"	3"	2.34	4.304	8/64"	4"
1.82	2.592	7/64"	3"	2.33	4.265	8/64"	4"	1.99	3.110	7/64"	3½"	2.50	4.909	8/64"	4"
1.93	2.906	7/64"	3"	2.47	4.791	8/64"	4"	2.11	3.495	7/64"	3½"	2.66	5.553	8/64"	4½"

* Approved by special permission only.

Signal and Communication Wiring Data

Wire sizes, dimensions and raceway data for types of conductors commonly used on signal, alarm and communication systems. Systems operating at substantial voltages and currents derived from power or lighting circuits are subject to code rules. On low voltage circuits line drop may also become a critically important consideration.

SINGLE TELEPHONE CABLE

No. Cond.	Single No. 22 & 4 Single No. 18					
	Braided			Leaded		
	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size
6	0.26	0.053	½"	0.30	0.071	½"
11	0.28	0.061	½"	0.33	0.086	½"
16	0.31	0.075	½"	0.36	0.102	½"
26	0.36	0.102	½"	0.40	0.126	¾"
35	0.40	0.126	¾"	0.45	0.159	¾"
45	0.44	0.152	¾"	0.48	0.181	¾"
55	0.46	0.165	¾"	0.51	0.204	¾"
65	0.51	0.204	¾"	0.55	0.236	1"
75	0.53	0.219	1"	0.59	0.255	1"
85	0.55	0.236	1"	0.60	0.283	1"
100	0.60	0.283	1"	0.64	0.322	1"

PAIR TELEPHONE CABLE

No. Pairs	Pairs No. 22 & 2 Pairs No. 18						Pairs No. 22 Only					
	Braided			Leaded			Braided			Leaded		
	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size
6	0.36	0.102	½"	0.45	0.159	¾"	0.29	0.066	½"	0.33	0.086	½"
12	0.41	0.132	¾"	0.50	0.196	¾"	0.38	0.133	½"	0.42	0.139	¾"
16	0.50	0.196	¾"	0.59	0.273	1"	0.42	0.139	¾"	0.47	0.174	¾"
22	0.57	0.255	1"	0.66	0.342	1"	0.49	0.188	¾"	0.53	0.220	1"
32	0.62	0.302	1"	0.71	0.396	1¼"	0.57	0.253	1"	0.61	0.292	1"
41	0.74	0.430	1¼"	0.85	0.567	1¼"	0.61	0.292	1"	0.66	0.342	1"
51	0.88	0.608	1½"	0.97	0.739	1½"	0.70	0.385	1¼"	0.76	0.454	1¼"
65	0.92	0.665	1½"	1.01	0.802	2"	0.76	0.454	1¼"	0.83	0.541	1¼"
75	0.95	0.709	1½"	1.03	0.833	2"	0.82	0.528	1¼"	0.89	0.622	1½"
85	0.98	0.754	1½"	1.07	0.899	2"	0.86	0.581	1¼"	0.93	0.679	1½"
100	1.08	0.916	2"	1.16	1.057	2"	0.94	0.694	1½"	1.01	0.802	1½"
125	1.18	1.094	2"	1.26	1.247	2"	1.01	0.802	1½"	1.08	0.916	2"
150	1.27	1.254	2"	1.34	1.410	2½"	1.12	0.985	2"	1.18	1.094	2"
175	1.37	1.474	2½"	1.44	1.624	2½"	1.18	1.094	2"	1.25	1.227	2"
200	1.45	1.649	2½"	1.57	1.938	3"	1.27	1.254	2"	1.34	1.410	2½"

DUPLEX & TRIPLEX

Size AWG	Insulation Rubber Braid		Maximum Conductors in Conduit					
	Over. Diam.	Approx. Area Sq. In.	½ in. Int. Area .30 Sq. In.	¾ in. Int. Area .53 Sq. In.	1 in. Int. Area .86 Sq. In.	1¼ in. Int. Area 1.50 Sq. In.	1½ in. Int. Area 2.04 Sq. In.	2 in. Int. Area 3.36 Sq. In.
22*	.20	.031	6	12	20	36	50	84
22†	.22	.038	9	15	24	45	60	102
19*	.24	.045	4	8	14	24	34	68
19†	.26	.053	6	9	18	33	45	75

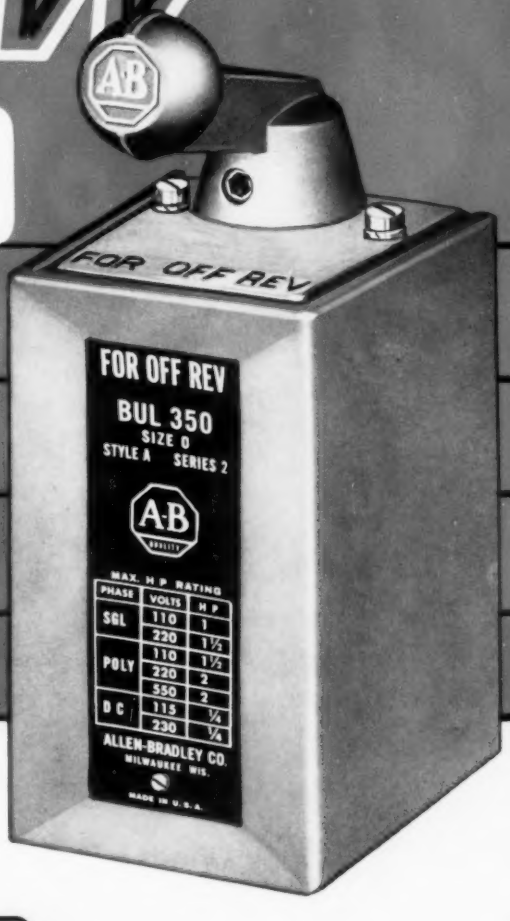
Note: * 2 Wire twisted.
† 3 Wire twisted.



ALLEN-BRADLEY

new

BULLETIN 350 reversing drum switch



Styled by Brooks Stevens, internationally famous industrial designer.

- *MODERN IN APPEARANCE*
- *AVAILABLE AS OILTIGHT— FOR CAVITY MOUNTING*
- *EASY TO MOUNT*
- *EASIER TO WIRE*
- *INSTANT CHANGEOVER FROM MAINTAINED TO MOMENTARY CONTACTS*

A-B QUALITY

ALLEN-BRADLEY

MOTOR CONTROL

QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

6-58-MR

A new "quality" standard for small REVERSING DRUM SWITCHES



A-B QUALITY



GOOD-LOOKING AND GOOD "FEELING" DIE CAST HANDLE

EASILY ACCESSIBLE MOUNTING HOLES

MERELY LOOSEN SCREW AND SLIDE PLATE to change from momentary to maintained contacts —or vice versa

INDEPENDENT SWITCH MOUNTING prevents misalignment

HEAVY CONTACT SURFACES for long operating life

TWO CONDUIT OPENINGS

WRAP-AROUND COVER gives complete access to drum

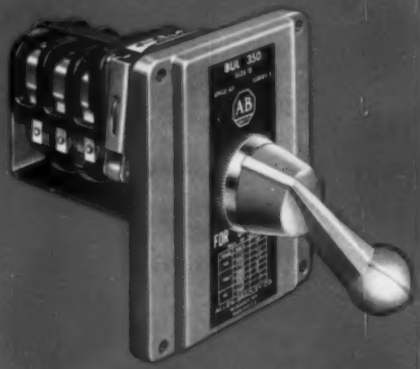
SINGLE SCREW COVER MOUNTING —screw cannot fall out

ACCESSIBLE SCREW TERMINALS for front wiring

RAISED EDGE for base mounting without spacers

maximum rating 2 horsepower

NEW OILTIGHT COVER PLATE FOR CAVITY MOUNTING



Bulletin 350 Reversing Switch can be furnished with oiltight cover plate with rubber gasket seal for cavity mounting in a machine base.

This *all-new* Allen-Bradley reversing drum switch was designed to keep pace with the mechanical beauty designed into so many of the modern machine tools.

The Bulletin 350 reversing switch is equivalent to a three-pole, double throw switch . . . and can be used with d-c motors; or single phase, two phase, or three phase a-c motors.

Investigate the Bulletin 350 . . . the *new leader* of its class . . . in appearance, ease of installation, and operating life. An Allen-Bradley *quality* switch . . . in every sense of the word. Send for descriptive bulletin.

ALLEN-BRADLEY

MOTOR CONTROL

QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

6-58-MR

the required number of pushbuttons and associated cardholders for every outlying telephone and other audible signals used in the program system. Adjacent to each pushbutton there shall be a set of openings each one representing a program circuit. A complete set of plugs shall be furnished, made to fit in these openings, and permitting internal connections from one program circuit to another, by means of horizontal circuit bars and vertical program circuit bars. A buzzer with cutoff switch shall be provided on this unit. At all outlying points, install the type of telephone indicated (cradle desk, flush or surface mounted with handphone or with watchcase receiver and built-in transmitter) by symbol without signal. Where cradle desk telephones are shown, provide same with 6-ft flexible cable, terminal strip box and associated buzzer signal.

Da. Install at each location where shown a handphone on cradle type desk (or flush or surface wall mounting with handphone or with watchcase receiver and built-in transmitter) telephone having mounted thereon—pushbuttons (or selector switch with—points) to call any other telephone in the system. (Provide desk unit with 6-ft flexible cable, terminal strip box and buzzer signal; others with bell signal.)

Db. (Same as paragraph Bb.)

Ea. Install at each location where shown a handphone on cradle type desk (or flush or surface wall mounting with handphone) telephone having mounted thereon—locking pushbuttons (or reset selector switch with points) to call any other telephone in the system. (Provide desk unit with 6-ft flexible cable, terminal strip box and buzzer signal; other bell signal.)

Fa. Install at each location where shown a handphone on cradle type desk (or flush or surface mounting with handphone or with watchcase receiver and built-in transmitter) telephone. (Provide desk unit with 6-ft flexible cable, terminal strip box and buzzer signal; other with bell signal.)

Fb. Install in telephone switchboard room a free-standing (or turret or desk type) common return, lamp signal, manual telephone switchboard. This unit shall be equipped for—line and lamp jacks (for all stations, plus 10%) or nearest largest standard switchboard manufactured, cross-connecting cords and ringing and listening keys, (based on five for first 50 lines plus one for each ten additional lines) buzzer and switch, headset and breastplate transmitter with cord and plug, line terminals in rear. The cross-connecting cords shall be complete with supervisory pilot lamps.

Ga. Install at each location where shown a handphone on cradle desk (or flush or surface wall mounting with handphone) telephone with automatic dial and ringer. (Provide desk unit with 6-ft flexible cable and terminal block.)

Gb. Install in machine room a complete automatic exchange unit. The machine switching equipment shall be fully equipped for lines, plus 25% space for future expansion, including switching and rack facilities, ringing apparatus, rectifier equipment, battery and rack.

Ha. Install in each suite a flush (or surface) wall type telephone provided with one pushbutton. (1) A talk and answer speaker mounted behind grille front with press-to-talk button; (2) a watchcase receiver built-in transmitter and hook-switch; (1, 2) together with necessary terminals and backbox.

Hb. Install in vestibule a (1) loudspeaking telephone; (2) non-loudspeaking telephone with armored cord receiver and built-in transmitter; (1, 2) with—pushbuttons and cardholders (one for each suite). Outer frame shall be designed to contain government approved mailboxes. Backbox to be provided for the telephone in vestibule.

Hc. Install a mortise type door-opener in main entrance door frame and fasten securely in place, and even with door lock.

11.14 Terminal strip cabinets

Furnish and install where shown on plans, flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors, plus 10% spares. Terminal strips must be mounted on a sheet of insulating material.

11.15 Power supply

The system shall operate from a dry plate rectifier power supply cabinet with a capacity of sufficient size to carry the load of the system. This unit shall have an input of 115 volts, 60-cycle ac derived from a separate circuit from the nearest lighting panel.

11.16 Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wire shall be color-coded and in general shall be standard heavy braided type, except in damp locations (or underground where it shall be lead-covered.) (A) Twisted pair No. 19 B & S gauge and two No. 18 single B & S gauge. (B, D, G, H) Cable with two pair No. 18 B & S gauge, balance single or paired No. 22 B & S gauge. (F, G) Cable with pairs No. 22 B & S gauge, branches twisted duplex or triplex No. 19 B & S gauge. (D) one twisted pair No. 19 B & S gauge, one common No. 18 B & S gauge, plus one No. 18 B & S gauge for each signal.

11.17 Finish

Finish on instruments shall be standard insofar as possible, except annunciators and manual switchboards which shall be as approved by the architect.

11.2 Public Telephone Systems

11.21 Gauge

Furnish and install a conduit system for the public telephones as recommended and specified by the (name of local public telephone company) and described in these specifications and indicated on wiring plans.

Furnish and install outlet boxes as required by the telephone company. Where these outlets are combined with other outlets, proper barriers must be provided.

11.22 Terminal strip cabinets

These cabinets shall be supplied and installed as required by the telephone company, less terminal strips; however, they must be of proper size and have the proper gutter requirements.

11.3 Sound Systems

A. Single channel without intercommunication.

B. Single channel and intercommunication.

C. Two channel with intercommunication.

D. Three channel with intercommunication.

11.31 General

Furnish and install a (trade name/ and or number) sound system (select type from A, B, C, D above) as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first class operating condition.

11.32 Functions and facilities

The equipment shall perform the following functions:

1. Receive and distribute radio pro-

(*Continued on page* 140)

SIGNAL SYSTEM CABLES

Rubber Covered

No. Cond.	No. 18—1/64" R*			No. 18—1/32" R			No. 16—1/64" R*			No. 16—1/32" R		
	Over. Diam.	Approx. Area Sq. In.	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Conduit Size
10	0.49	0.188	¾"	0.61	0.292	1"	0.53	0.219	1"	0.65	0.330	1"
20	0.63	0.314	1"	0.80	0.503	1¼"	0.69	0.377	1¼"	0.85	0.565	1¼"
30	0.74	0.322	1¼"	0.94	0.691	1½"	0.81	0.518	1¼"	1.01	0.802	1½"
40	0.83	0.541	1¼"	1.06	0.880	2"	0.92	0.668	1½"	1.14	1.021	2"
50	0.93	0.675	1½"	1.18	1.094	2"	1.02	0.817	1½"	1.27	1.254	2"
60	1.00	0.785	1½"	1.28	1.288	2"	1.10	0.950	2"	1.38	1.492	2½"
70	1.10	0.950	2"	1.41	1.563	2½"	1.21	1.147	2"	1.53	1.838	2½"
80	1.15	1.037	2"	1.48	1.720	2½"	1.27	1.254	2"	1.60	2.011	3"
90	1.21	1.147	2"	1.54	1.861	2½"	1.32	1.367	2½"	1.67	2.191	3"
100	1.28	1.288	2"	1.66	2.168	3"	1.41	1.563	2½"	1.79	2.513	3"
125	1.40	1.539	2½"	1.82	2.592	3"	1.56	1.909	2½"	1.96	2.974	3½"
150	1.54	1.861	2½"	1.99	3.110	3½"	1.70	2.260	3"	2.15	3.628	3½"
175	1.66	2.168	3"	2.14	3.596	3½"	1.83	2.631	3"	2.31	4.163	4"
200	1.77	2.458	3"	2.28	4.084	4"	1.95	2.984	3½"	2.47	4.791	4"

* Approved by special permission only.

GROUPED SINGLE CONDUCTORS

Size AWG	Insulation RF 32, R, RH, RW*		Insulation TF, T, TW, RU* RUF, RUW		Insulation RF-64**		Maximum Number Conductors in Conduit						
	Over. Diam.	Approx. Area Sq. In.	Over. Diam.	Approx. Area Sq. In.	Over. Diam.	Approx. Area Sq. In.	½ in. Int. Area .30 Sq. In.	¾ in. Int. Area .53 Sq. In.	1 in. Int. Area .86 Sq. In.	1¼ in. Int. Area 1.50 Sq.In.	1½ in. Int. Area 2.04 Sq.In.	2 in. Int. Area 3.36 Sq.In.	2½ in. Int. Area 4.79 Sq.In.	3 in. Int. Area 7.38 Sq.In.
18	.146	.0167	.106	.0088			7	12	20	35	49	80	115	176
18					.100	.0079	14	24	42	73	100	165	236	364
16	.158	.0196	.118	.0109			6	10	17	30	41	68	97	150
16					.113	.0100	12	19	33	58	79	131	186	287
14	.171	.0230	.131	.0135			4	6	10	18	25	40	59	90
12	.188	.0278	.148	.0172			3	5	8	15	21	35	50	77
10	.242	.0460	.168	.0224			2	4	7	13	17	29	41	64
8	.311	.0760	.228	.0408			1	3	4	7	10	17	25	38
6	.397	.1238	.323	.0819			1	1	3	4	6	9	15	23

Combination of Conductors

*		**	
1—No. 14 Equal to		1—No. 18 or 1 No. 16	3—No. 18 or 2 No. 16
2— " " " "		2— " " " 2 " "	5— " " " 4 " "
3— " " " "		4— " " " 3 " "	8— " " " 7 " "
1— " 12 " "		1— " " " 1 " "	3— " " " 3 " "
2— " " " "		3— " " " 3 " "	7— " " " 5 " "
3— " " " "		4— " " " 4 " "	10— " " " 8 " "

Note: *In accordance with NEC.
**Approved by special permission.

Above sizes apply to straight runs or with nominal offsets equivalent to not more than two quarter-bends

PAGING SYSTEM CABLES

No. Cond.	No. 14—3/64" R			No. 12—3/64" R			No. 14—3/64" RL				No. 12—3/64" RL			
	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Cond. Size	Over. Diam.	Approx. Area Sq.In.	Thick Lead	Cond. Size
12	0.84	0.554	1½"	0.94"	0.680	1½"	0.97"	0.738	5/64"	1½"	1.05	0.864	5/64"	2"
20	1.10	0.950	2"	1.19"	1.112	2"	1.20"	1.130	5/64"	2"	1.32	1.367	3/32"	2½"
24	1.21	1.147	2"	1.31"	1.348	2"	1.35"	1.420	5/64"	2½"	1.45	1.649	3/32"	2½"

gram material to any combination of room speakers. (ABCD)

2. Distribute announcements from the console to any combination of room speakers. (ABCD)

3. Distribute disc recorded program material to any combination of room speakers. (ABCD)

4. Receive and distribute tape recorded program material for any combination of room speakers. (ABCD)

5. Receive and distribute program material from one of two remote program sources to any combination of room speakers. (ABCD)

6. Receive and distribute program material from two and up to possibly four remote program sources to any combination of room speakers. (CD)

7. Select and mix program material from two microphones for single channel transmission. (ABCD)

8. Select and mix program material from four microphones for dual channel transmission. (D)

9. Select and mix program material from two microphones and one other program material source (Radio, Phono, Remote No. 1, Remote No. 2, Tape) for single channel distribution. (ABCD)

10. Select and mix program material from two microphones and one other program material source, (Radio, Phono, Remote No. 1, Remote No. 2, Tape) for single channel distribution, plus one other program material source (Radio, Phono, Remote No. 1, Remote No. 2 and Tape) or the local microphone for distribution via a second channel. (CD)

11. Select and mix program material from two microphones and one other program material source (Radio, Phono, Remote No. 1, Remote No. 2, Tape and Room Pickup), for distribution of separate programs on two program channels simultaneously plus one other program material source (Radio, Phono, Remote No. 1, Remote No. 2, Tape) or the local microphone for distribution via a third channel. (D).

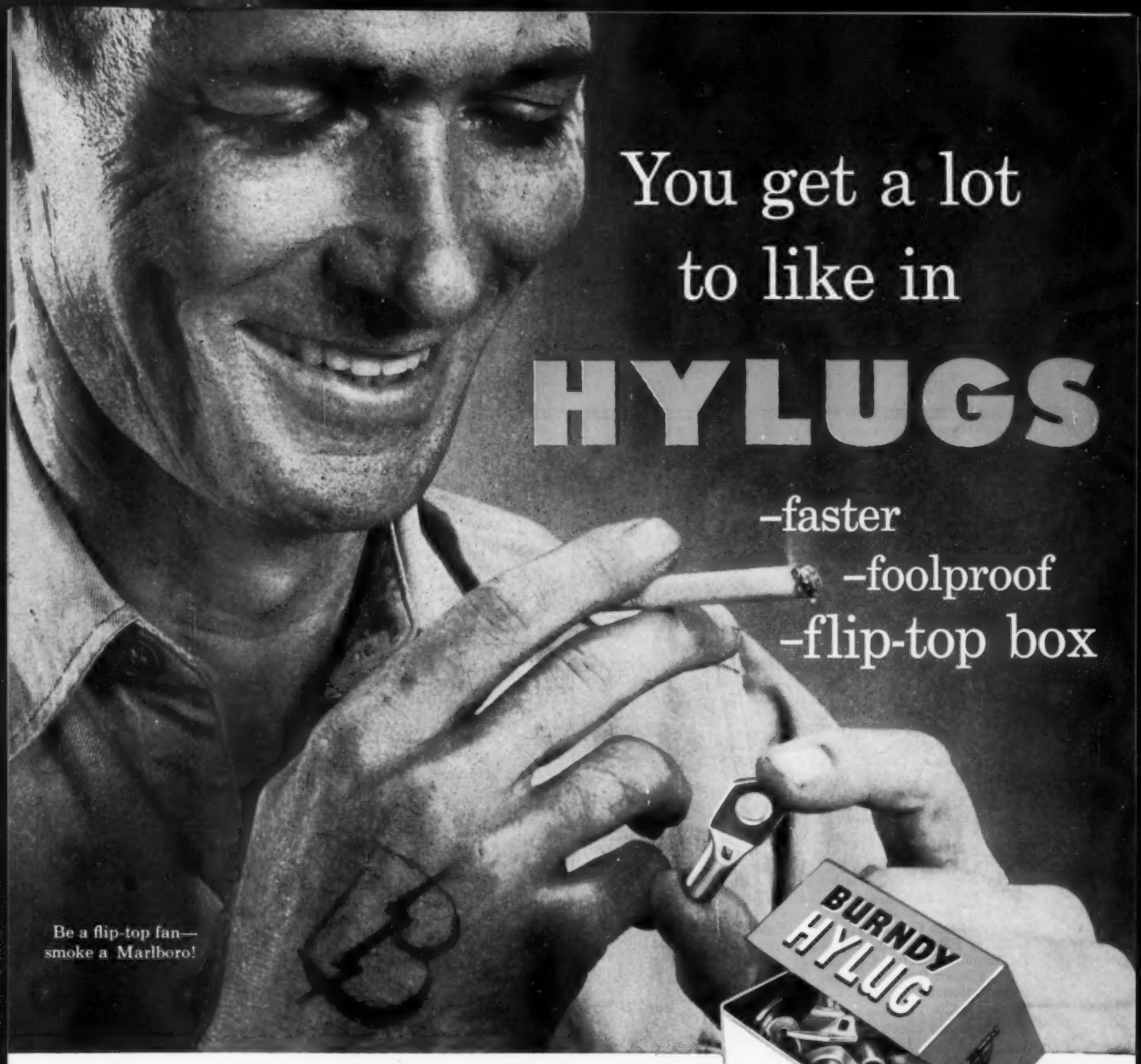
12. Intercommunicate with any one room speaker by means of the program channel. (B)

13. Intercommunicate with any one room speaker without interrupting program material being distributed to any other room speaker. (CD)

14. Select the console monitor speaker or a console microphone for intercommunication with room speaker. (BCD)

15. Visually indicate overload levels

(*Continued on page* 226)



Yes, there's lots to like in Burndy Hylugs — now packed in the new foolproof, faster, flip-top box! Wire, Hylug and stud sizes clearly marked on every box. Separate color-coded boxes for Hylugs and Hylinks. No more fussing, fumbling in your kit! Flick out the Hylug flip-top box, flip open the cover — make fast, dependable Burndy Hydent connections — indent on any side of barrel — controlled by the easy-to-use Burndy Hytool. Available in the flip-top box thru No. 8. In sturdy corrugated boxes up to 2000 MCM. Buy them today!

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Advertisers' Product Index

ELECTRICAL CONSTRUCTION & MAINTENANCE • MAY, 1958

The listings under major product headings are of manufacturers advertising those products in this issue in sufficient detail to be of value to specifiers or users of those products.

It is recommended that manufacturers' advertisements listed under each product heading be referred to in order to get complete information.

Bus, Trolley and Duct Systems

Adam Electric Co., Frank 194, 195
Aluminum Co. of America 53, 178
BullDog Electric Products Co. 179, 180, 181, 182
Calvert Co., The 282
Continental Electric Equipment Co. 197
Cope, Inc., T. J. (Div. of Rome Cable Corp.) 320
Electrical Distribution Products, Inc. 334
Feedrail Corp. 281
General Electric Co. (Construction Materials Div.) 22, 23, 242, 243
Graybar Electric Co., Inc. 72
Huenefeld Co., The 240
Husky Products, Inc. 221
Insul-8-Corp. 332
Johns-Manville 64
Keystone Manufacturing Co. 227
National Electric Products Corp. 212, 213
Reynolds Metal Co. 237
Square D Co. ..... Third Cover, 16, 17, 204, 205
Westinghouse Electric Corp. (Pittsburgh) 147, 148, 149, 150, 151, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163

Circuit Breakers

Adam Electric Co., Frank 194, 195
Allis-Chalmers Mfg. Co. 168, 296, 301
BullDog Electric Products Co. 179, 180, 181, 182
Crouse-Hinds Co. ..... Fourth Cover, 186, 187
Graybar Electric Co., Inc. 72
Heinemann Electric Co. 236
I-T-E Circuit Breaker Co. 173, 174, 175, 176, 177
Pyle-National Co., The 15
Square D Co. ..... Third Cover, 16, 17, 204, 205
Westinghouse Electric Corp. (Pittsburgh) 147, 148, 149, 150, 151, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163

Conduit Fittings and Accessories

Appleton Electric Co. 2
Blackhawk Industries 270
Briegel Method Tool Co. 70
Conduit Nipple Mfg. Co. 284
Crouse-Hinds Co. ..... Fourth Cover, 186, 187
Electric Tube Products 57
Gedney Electric Co. 27
Graybar Electric Co., Inc. 72
Ideal-Simplet Fittings, Inc. 321
Killark Electric Mfg. Co. 201

Conduit, Flexible

American Brass Co., The (American Metal Hose Branch) 216, 217
Electri-Flex Co. 228
Graybar Electric Co., Inc. 72

Conduit, Non-Metallic

Graybar Electric Co., Inc. 72
Orangeburg Mfg. Co., Inc. 46
United States Rubber Co. 19

Conduit, Rigid

Aluminum Co. of America 53, 178
General Electric Co. (Construction Materials Div.) 22, 23, 242, 243
Graybar Electric Co., Inc. 72
National Electric Products Corp. 212, 213
Pittsburgh Standard Conduit Co. 59
Steelduct Co., The 143
Triangle Conduit & Cable Co., Inc. 33, 34, 35, 36
Youngstown Sheet & Tube Co., The 28

Conduit, Thinwall, E. M. T.

Circle Wire & Cable Corp., Subsidiary of Cerro De Pasco Corp. 166, 167
Graybar Electric Co., Inc. 72
National Electric Products Corp. 212, 213
Steelduct Co., The 143

Fans, Heating and Ventilating Equipment, Blowers and Coolers

Berko Electric Co. 266
Buffalo Forge Co. 268
Fasco Industries, Inc. 51
Graybar Electric Co., Inc. 72
Ilg Electric Ventilating Co. 169
Wiegand Co., Edwin L. 239

Fuses

Bussmann Mfg. Co. (Div. of McGraw Electric Co.) 12, 13
Eagle Electric Mfg. Co. 226
Economy Fuse & Mfg. Co. 58
Graybar Electric Co., Inc. 72

Hanging and Fastening Devices

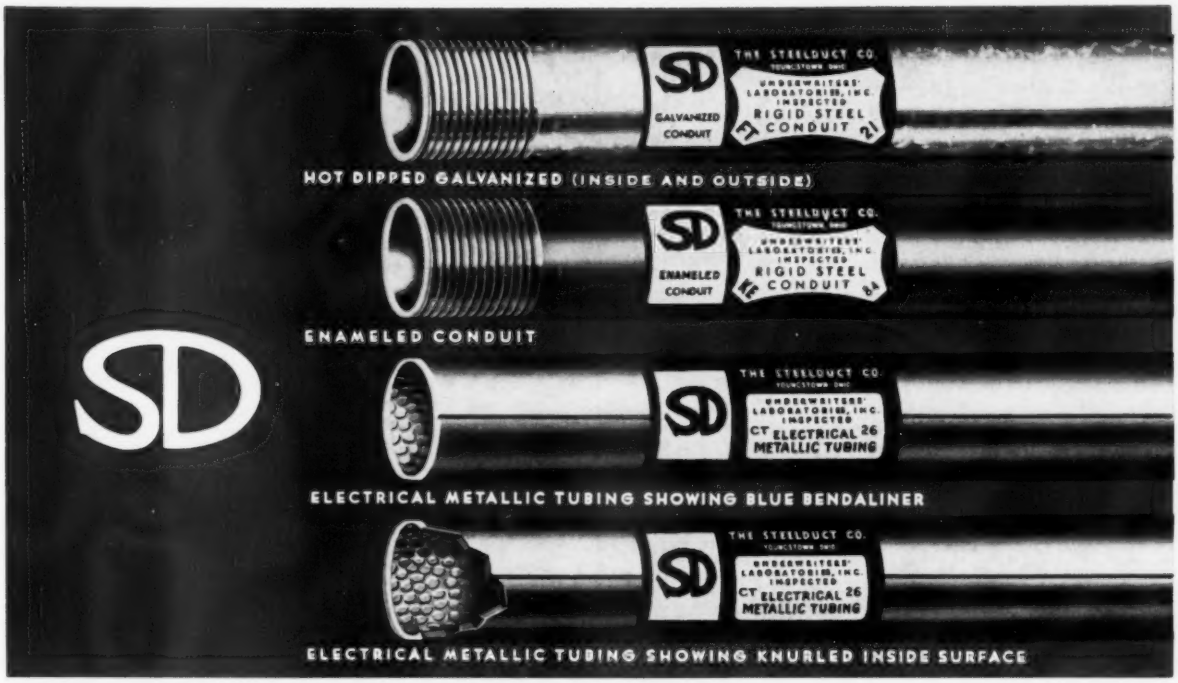
Arro Expansion Bolt Co. 327
Blackhawk Industries 270
Graybar Electric Co., Inc. 72
Holub Industries, Inc. 269
Polis Manufacturing Co., J. D. 329
Star Expansion 277
Thiel Tool & Engineering Co., Inc. 292
U. S. Expansion Bolt Co. 280

Instruments, Testing

Amprobe, A Div. of Pyramid Instr. Corp. 283
Biddle Co., James G. 300
Graybar Electric Co., Inc. 72
Square D Co. ..... Third Cover, 16, 17, 204, 205
Sticht Co., Inc., Herman H. 331

Lighting Equipment, Outdoor

Crouse-Hinds Co. ..... Fourth Cover, 186, 187
General Electric Co. (Apparatus Sales Div.) 40, 41, 42, 43, 44, 45
Graybar Electric Co., Inc. 72
Killark Electric Mfg Co. 201
Multi Electric Mfg., Inc. 252
Revere Electric Mfg. Co. 304, 313
Thompson Electric Co., Inc. 264



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Advertisers' Product Index

Lighting Fixtures and Accessories

American Louver Co. 288
Appleton Electric Co. 2
Corning Glass Works 183
Crouse-Hinds Co. .....Fourth Cover, 186, 187
Curtis Lighting, Inc. 32
Day-Brite Lighting, Inc. 210, 211
Exide Industrial Div.,
The Electric Storage Battery Co. 245
Fasco Industries, Inc. 51
Federal Lighting Corp. 293
Garden City Plating & Mfg. Co. 188
Graybar Electric Co., Inc. 72
Guth Co., Edwin F., The .....Second Cover, 37
Holophane Co., Inc. 196

Killark Electric Mfg. Co. 201
Kirkland Co., H. R., The 284
Lightolier 249
Litecontrol Corp. 52
Markstone Mfg. Co. 271
McGill Mfg. Co. 38
McPhilben Mfg. Co. 200
Metalcraft Products Co., Inc. 244
Miller Co., The 215
Mitchell Mfg. Co. 307
Multi Electric Mfg., Inc. 252
Pittsburgh Reflector Co. 218
RLM Standards Institute, Inc. 224
Rohm & Haas Co. 62
Ruby-Philite Corp. 265
Smithcraft Lighting 267
Sunbeam Lighting Co. 199
Sylvania Electric Products 60, 61, 250, 251
Thomas Industries, Inc. 191
Virden Co., John C. 24, 25
Westinghouse Electric Corp. (Lighting Div.) ..164, 165
Wiley, Inc., R. & W. 314
Woodhead Co., Daniel 328

Lighting, Lamps, Ballasts and Transformers

Advance Transformer Co. 171, 172
Certified Ballast Mfgrs. 18
Champion Lamp Works 276
Graybar Electric Co., Inc. 72
Sola Electric Co. 220
Sylvania Electric Products 60, 61, 250, 251
Westinghouse Electric Corp. (Lamp Div.) 152

Motor Controls and Apparatus

Allen-Bradley Co. 137, 138
Allis-Chalmers Mfg. Co. 168, 296, 301
Arrow-Hart & Hegeman Electric Co., The 278, 279
Automatic Switch Co. 189, 190
Clark Controller Co., The 170
Continental Electric Equipment Co. 197
Electric Controller & Mfg. Div., Square D Co. 1
Furnas Electric Co. 294
Graybar Electric Co., Inc. 72
Square D Co. .....Third Cover, 16, 17, 204, 205
Westinghouse Electric Corp. (Pittsburgh)
147, 148, 149, 150, 151, 153, 154, 155,
156, 157, 158, 159, 160, 161, 162, 163

Motors, Generators and Parts

Brook Motor Corp. 270
Century Electric Co. 241
Graybar Electric Co., Inc. 72
Helwig Co. 284
Onan & Sons, Inc., D. W. 269
Universal Motor Co. 329
Wagner Electric Corp. 207, 208, 318
Westinghouse Electric Corp. (Pittsburgh)
147, 148, 149, 150, 151, 153, 154, 155,
156, 157, 158, 159, 160, 161, 162, 163
Winpower Mfg. Co. 326

Outlet Boxes, Boxes, Plaster Rings, and Hangers

Adalet Mfg. Co., The 266
All-Steel Equipment, Inc. 29
Arrolet Corp. 272
Fullman Mfg. Co. 289
Graybar Electric Co., Inc. 72
Huenefeld Co., The 240
Kees Mfg. Co., F. D. 280
Keystone Mfg. Co. 227
National Electric Products Corp. 212, 213
Russell & Stoll Co., Inc. 145

Panelboards, Switchboards, Switchgear and Accessories

Adam Electric Co., Frank 194, 195
BullDog Electric Products Co. 179, 180, 181, 182
Continental Electric Equipment Co. 197
Crouse-Hinds Co. .....Fourth Cover, 186, 187
General Electric Co. (Apparatus Sales Div.)
40, 41, 42, 43, 44, 45
Graybar Electric Co., Inc. 72
I-T-E Circuit Breaker Co. 173, 174, 175, 176, 177
S & C Electric Co. 309
Square D Co. .....Third Cover, 16, 17, 204, 205
Wadsworth Electric Mfg. Co., Inc. 292
Westinghouse Electric Corp. (Pittsburgh)
147, 148, 149, 150, 151, 153, 154, 155,
156, 157, 158, 159, 160, 161, 162, 163

Scaffolding, Racks and Cable Trays

Acme Steel Co. 68
Globe Co., The 230
Graybar Electric Co., Inc. 72
Up-Right Scaffolds 50

Service Entrance Masts and Porcelain Insulators

Graybar Electric Co., Inc. 72
Porcelain Products, Inc. 330, 331

Services, Pricing, Bidding and Repair

Black & Decker Mfg. Co. 192, 193, 268
Dodge Corp., F. W. 198
Henderson Hazel Corp. (National Price Service) .. 308

Solderless Lugs, Connectors, Clamps, and Accessories

AMP, Inc. 69
Burndy Corp. 141
Dossert Mfg. Corp. 49
Efficiency Electric Mfg. Co. 287
Erico Products, Inc. 229
Graybar Electric Co., Inc. 72
Ideal Industries, Inc. 209, 238
M & W Electric Mfg. Co., Inc. 328
O. Z. Electric Mfg. Co. 246, 247
P.L.M. Products, Inc. 292
Pyle National Co. 15
Thomas & Betts Co. 225

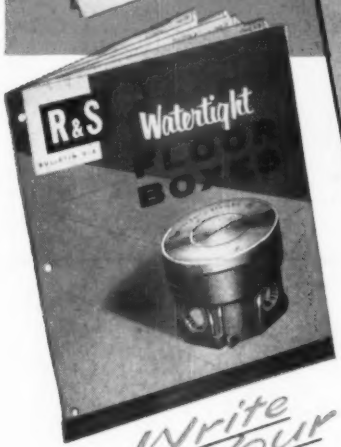
Sound, Signal and T.V. Equipment

American Telephone & Telegraph Co.
(Bell Telephone System) 14
Auth Electric Co., Inc. 20
Crouse-Hinds Co. .....Fourth Cover, 186, 187
Edwards Co., Inc. 222, 223
Graybar Electric Co., Inc. 72
Hose-McCann Telephone Co., Inc. 289
Kellogg Switchboard & Supply Co. 282
Kirkland Co., H. R., The 284
Minneapolis-Honeywell Regulator Co. 253
Mosley Electronics, Inc. 291
Radio Corp. of America 255
Sperti-Faraday, Inc. 315
Tevco Insulated Wire Co. 314

Substations, Unit

BullDog Electric Products Co. 179, 180, 181, 182
Continental Electric Equipment Co. 197
Graybar Electric Co., Inc. 72
I-T-E Circuit Breaker Co. 173, 174, 175, 176, 177
Square D Co. .....Third Cover, 16, 17, 204, 205





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Floor Boxes provide ready access to below-floor circuits for receptacles and fittings. They're an important factor in the overall effectiveness of electrical wiring systems in building projects. But they are *not* standardized—different makes vary greatly in quality, design, component constructions and performance.

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The group picture above, depicts the different types of R & S Floor Boxes and accessories required to meet every type of building construction.

of the 24-page R & S Floor Box Bulletin No. 4-A-4

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Advertisers' Product Index

Switches, Safety

BullDog Electric Products Co. 179, 180, 181, 182
Cutler Hammer, Inc. 26
Graybar Electric Co., Inc. 72
Heinemann Electric Co. 236
Square D Co. .....Third Cover, 16, 17, 204, 205
Wadsworth Electric Mfg. Co., Inc. 292
Westinghouse Electric Corp. (Pittsburgh)
147, 148, 149, 150, 151, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163

Switches, Time, Transfer, Precision and Specialized Control

Allen-Bradley Co. 137, 138
Automatic Switch Co. 189, 190
Delta-Star Electric (Div. of H. K. Porter Co., Inc.) . 303
Graybar Electric Co., Inc. 72
International Register Co. 248
Micro Switch (Div. of Minneapolis-Honeywell Regulator Co.) 206
Reliance Automatic Lighting Co. 326
Sangamo Electric Co. 260
Square D Co. .....Third Cover, 16, 17, 204, 205
Zenith Electric Co. 330

Tape, Electrical

Accurate Mfg. Co. 6
Boston Woven Hose & Rubber Co. 56
Dutch Brand Div., Johns Manville Corp. 11
Graybar Electric Co., Inc. 72
Jenkins Bros. 65
Plymouth Rubber Co. 235
Quaker Rubber (Div. of H. K. Porter Co., Inc.) ... 302

Tools

Black & Decker Mfg. Co. 192, 193, 268
Briegel Method Tool Co. 70
Graybar Electric Co., Inc. 72
Greenlee Tool Co. 234
Ideal Industries, Inc. 209, 238
Kalamazoo Tank & Silo Co. 289
Lidseen of North Carolina 271
Nye Tool Co. 292
Princeton Griphoist, Inc. 272
Ramset Fastening, Inc. 254
Remington Arms Co., Inc. 259
Ridge Tool Co. 273
Utica Drop Forge & Tool (Div. of Kelsey-Hayes Co.) 312
Velocity Power Tool Co. 322

Transformers

Allis-Chalmers Mfg. Co. 168, 296, 301
General Electric Co. (Apparatus Sales Div.) 40, 41, 42, 43, 44, 45
Graybar Electric Co., Inc. 72
Hevi-Duty Electric Co. 272
Hill Transformer Co., Inc. 277
I-T-E Circuit Breaker Co. 173, 174, 175, 176, 177
Kuhlman Electric Co. 306
Land-Air, Inc. 282
Marcus Transformer Co., Inc. 284
Precision Transformer Corp. 317
Sorgel Electric Co. 48
Standard Transformer Co. 262
Uptegraff Mfg. Co., R. E. 232, 233
Utility Transformer & Equipment Co. 330
Wagner Electric Corp 207, 208, 318
Westinghouse Electric Corp. (Pittsburgh)
147, 148, 149, 150, 151, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163

Truck Bodies

Reading Body Works 256

Wire and Cable

American Steel & Wire (Div. of U. S. Steel Corp.) 184, 185
Anaconda Wire & Cable Co. 30, 31
Columbia Cable & Electric Corp. 39
Crescent Insulated Wire & Cable Co. 67
Diamond Wire & Cable Co. 231
General Cable Corp. 21
Graybar Electric Co., Inc. 72
Kaiser Aluminum & Chemical Sales, Inc. 219
Narragansett Wire Co. 63
National Electric Products Corp. 212, 213
Okonite Co., The 310
Paranite Wire & Cable (Div. of Essex Wire Corp.) . 214
Phelps Dodge Copper Products Corp. 202, 203
Rockbestos Products Corp. 257
Rome Cable Corp. 261, 263
Royal Electric Corp. 258
Simplex Wire & Cable Co. 4
Triangle Conduit & Cable Co. Inc. 33, 34, 35, 36
Whitney-Blake Co. 290

Wire Pulling Compound

Electro-Compound Co. 287
Graybar Electric Co., Inc. 72
Minerallac Electric Co. 331

Wiring Devices

Arrow-Hart & Hegeman Electric Co. 278, 279
Bell Electric Co. 286, 287
Bryant Electric Co. 54, 55
Crouse-Hinds Co. .....Fourth Cover, 186, 187
Graybar Electric Co., Inc. 72
Hoffman Engineering Corp. 280
Hubbell, Inc., Harvey 8
Leviton Mfg. Co. 285
National Electric Products Corp. 212, 213
Pass & Seymour, Inc. 47
Pyle-National Co., The 15
Remcon, A Div. of Pyramid Instrument Corp. .274, 275
Rodale Mfg. Co. 325
Sierra Electric Corp. 66
Slater Electric Co. 308
Wiremold Co. 333

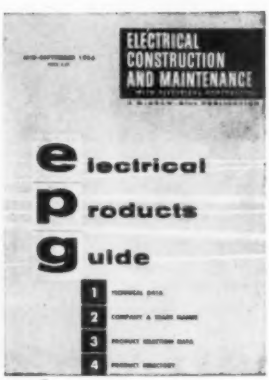
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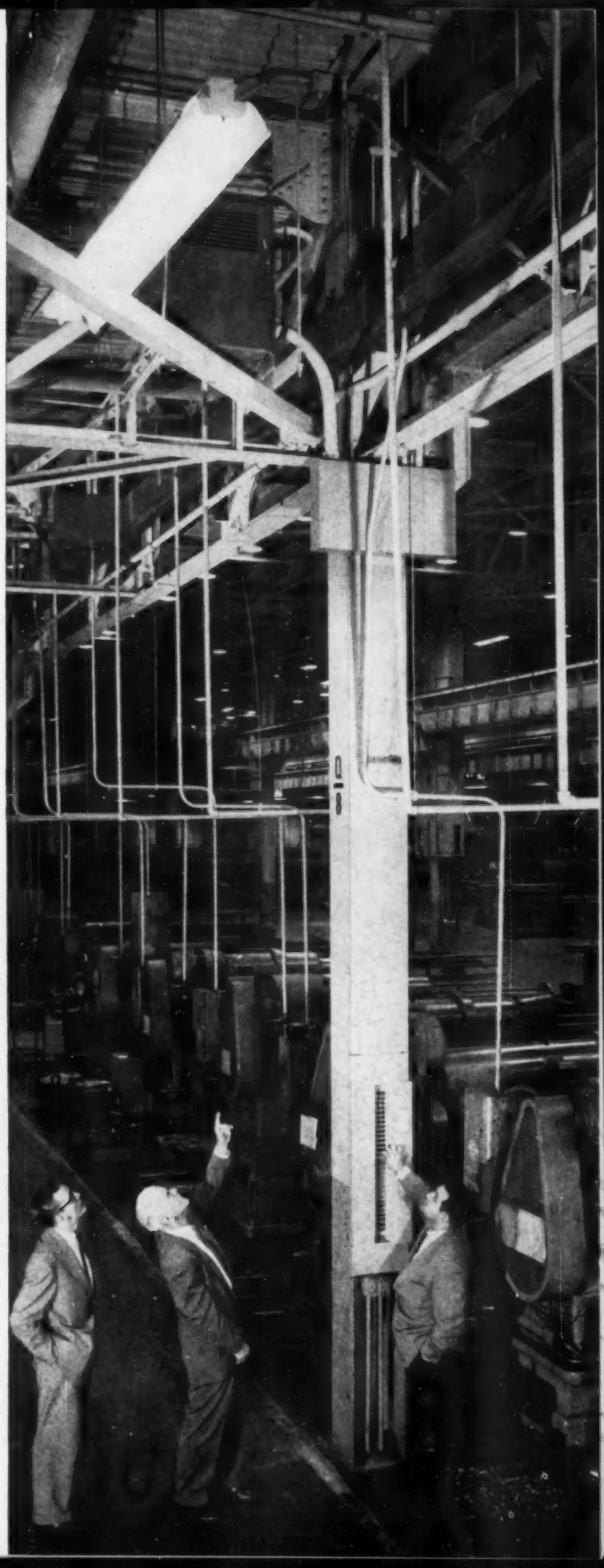




Westinghouse electrical system specified to Power-Up Ford products plant

YOU CAN BE SURE... IF IT'S Westinghouse

COVER PHOTO: Assembled in the plant layout room of the Ford Motor Co., General Products Division Plant, Indianapolis, Ind., are: Melvin Wetterlin, Westinghouse Sales Engineer, J. Vance Garinger, Project Engineer, Hatfield Electric Co., Inc., Electrical Contractors; S. V. Cornforth, Maintenance Engineer, Plant Engineering Department, Ford, Indianapolis; D. A. Kerry, Supervisor, Ford General Products Division Staff, Dearborn, Michigan; H. P. Jones, Manager, Plant Engineering Department, Ford, Indianapolis; James Miller, Westinghouse Construction Sales Engineer; and R. Richards, Supervisor, Engineering Planning, Plant Engineering Department, Ford, Indianapolis.



Melvin Wetterlin, J. Vance Garinger, and J. Rodriquez, Power and Waste Supervisor, Plant Engineering Department, Ford, Indianapolis, look overhead to identify the Westinghouse 45-kva DT-3 dry-type transformer, Westinghouse aluminum bus duct and Westinghouse fluorescent and high-bay lighting. Westinghouse NLAB-LX column-type panelboard, shown with trough and pullbox, is fed from the secondary of the dry-type transformer above.



Main entrance to Steering Gear and Cold Heading Plant, General Products Division, Ford Motor Company, Indianapolis, Indiana. Westinghouse electrical distribution system is used to meet present electrical needs, provide the necessary flexibility to permit extensive rearrangement of production machinery whenever required and to assure maximum facility in expanding to satisfy all future demands.

J-94104-2

Ford plant planning anticipates future power needs

The Ford Motor Company plant in Indianapolis, Indiana, where these pictures were taken, occupies more than 1,400,000 square feet of floor area. It requires a constant power supply of 26,500-kva. The combination of great size, large capacity and exacting, but frequently varying, production schedules makes it imperative that plant engineering must go beyond careful control of everyday operation. Planning for future demands becomes equally important.

Westinghouse, working with architects, consulting engineers, general contractors, electrical contractors and Ford engineers, had an active part in equipping this plant with the electrical distribution system and with other electrical components required to assure uninterrupted operation and provide for anticipated expansion. For example, 144 Westinghouse dry-type transformers of various ratings are mounted at heights varying from 22 to 45 feet above floor level, above conveyor trusses. The light weight, ease of installation and minimum maintenance requirements of these dry-type transformers have made it possible to locate them so each provides the required voltage, with minimum loss, to the equipment it supplies.

Over 6000 Westinghouse high-bay mercury vapor fixtures give daylight-type lighting in production areas, and these are supplemented by Westinghouse fluorescent lighting for the general illumination required by nighttime clean-up workers.

Approximately 2½ miles of Westinghouse 600-amp, 480-v, 3-pole, aluminum plug-in bus duct, mounted in 17 parallel straight runs (shown as

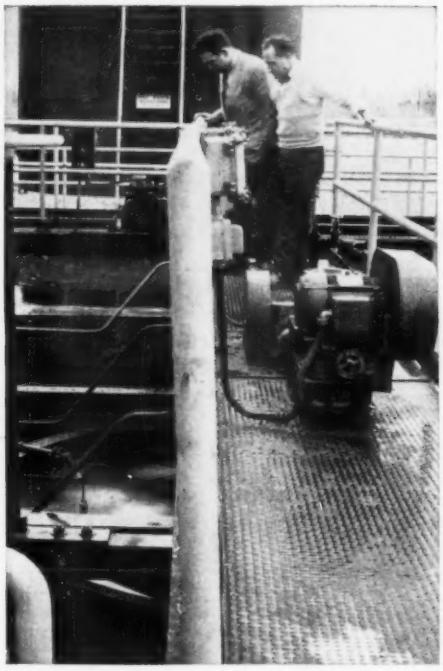
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J-94104-3

YOU CAN BE SURE...IF IT'S **Westinghouse**



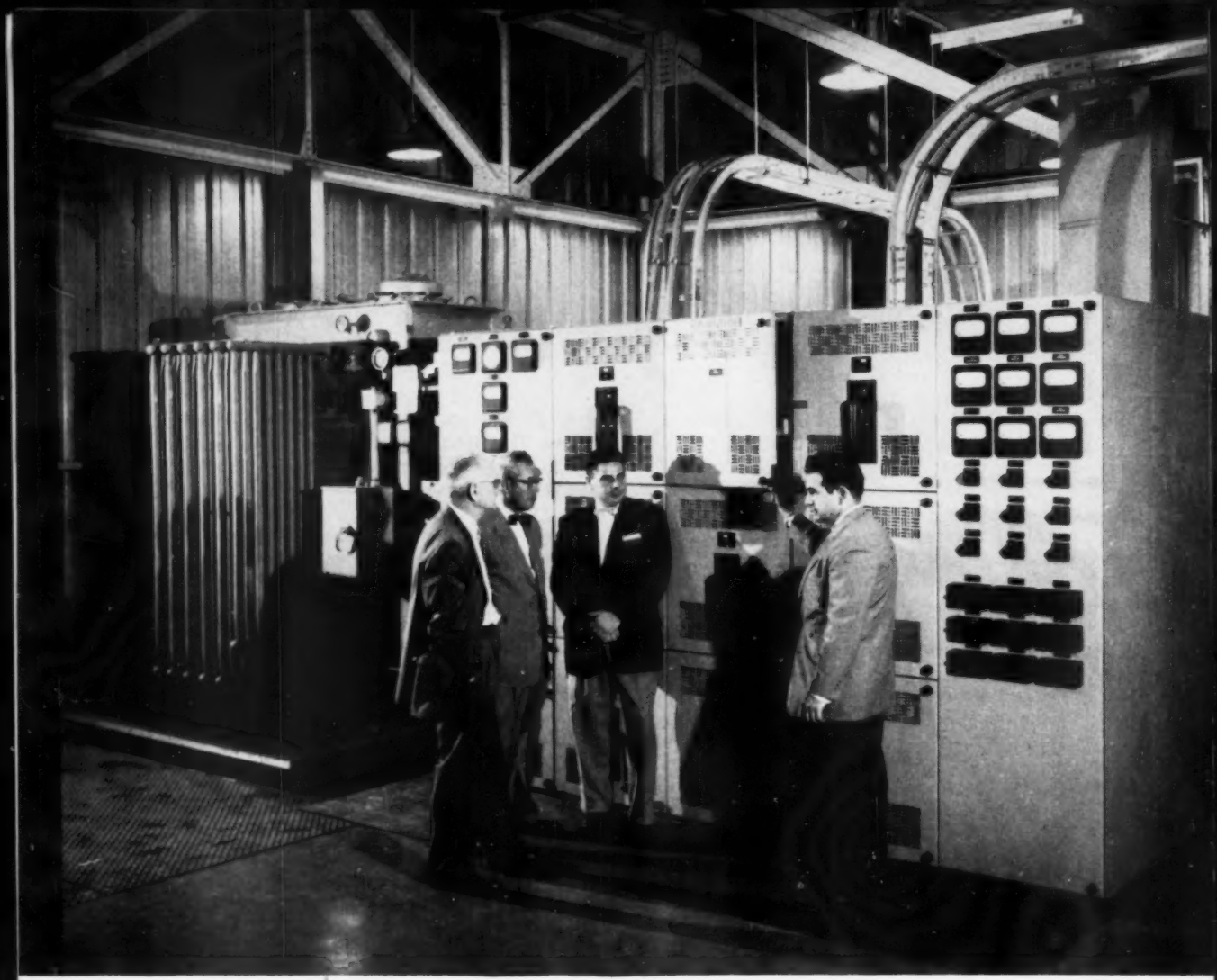
J. Rodriquez checks substation meter to make certain power factor constant at 98% lag is being maintained throughout the plant. This extreme efficiency of the electrical system is made possible by the use of Westinghouse capacitors.



J. Rodriquez and W. D. Eason, Engineer, Waste Treatment Plant, Plant Engineering Department, stand beside Westinghouse 7.5-hp totally enclosed Life-Line® "A" motor which drives the waste oil recovery tank agitator.



Shown between Lloyd L. Williams, Branch Mgr., WESCO, Indianapolis, and Paul E. Butalla, Main. Supvr., Plant Engin. Dept., Ford, Indianapolis, is Westinghouse Slipsyn® synchronous motor starter providing automatic starting and field application control for Westinghouse 400-hp, 440-volt motor.



J. Vance Garinger, Lloyd Williams, C. E. Hamm, Sales Rep., WESCO, Indianapolis, and J. Rodriquez shown before one of the nine power centers which distribute the 26,500-kva load throughout the plant. Power centers have stand-by circuit breakers and blank cubicles equipped for future needs.

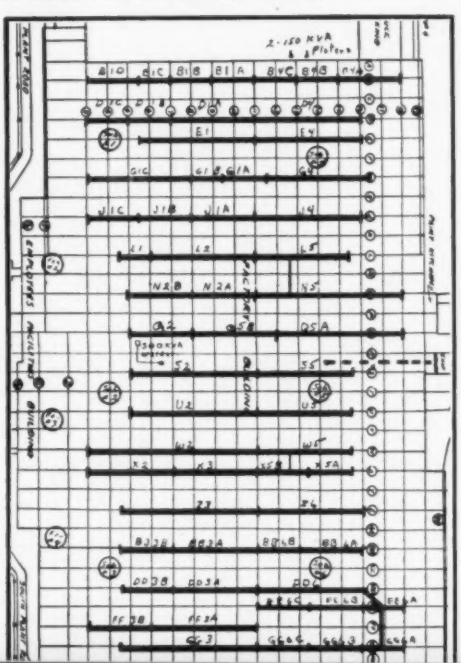
Ford plant planning anticipates future needs *(continued)*

heavy black lines in diagram), have been installed to provide maximum flexibility in locating production machinery.

Westinghouse can help you with any phase of your electrical planning and construction. See your Westinghouse distributor, or write Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

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Indianapolis, Indiana

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For your copy of PANELBOARD PLANNING (Publication B-6098-B), see your Westinghouse sales representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

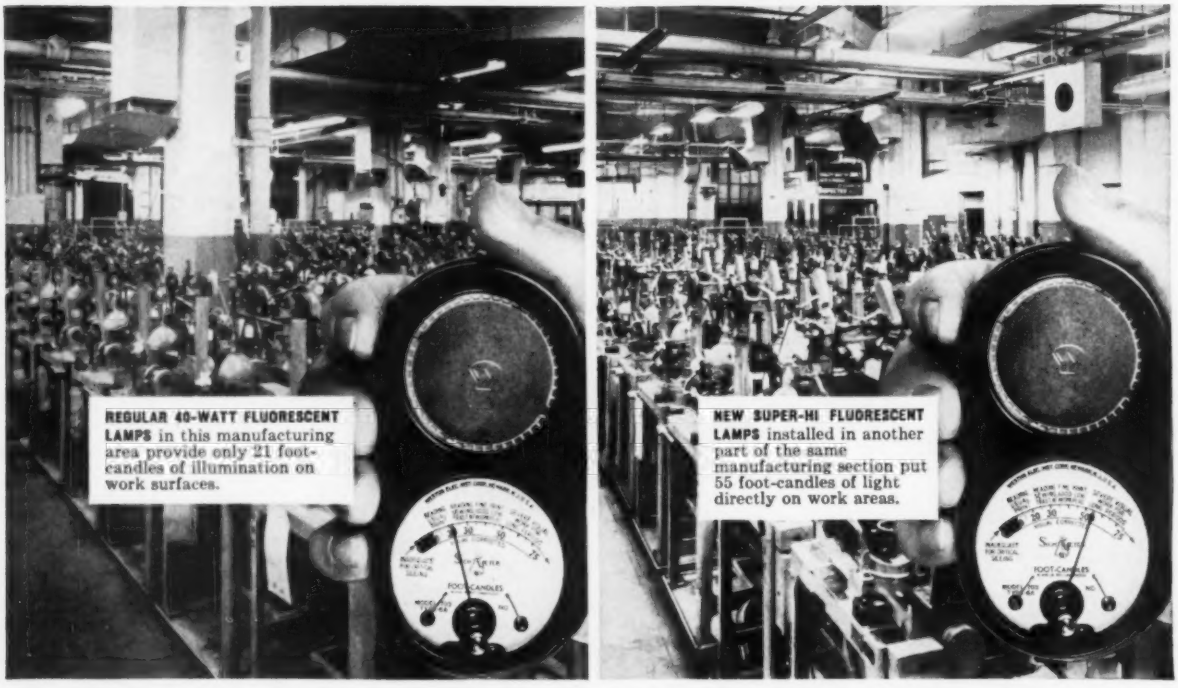
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FLUORESCENT LAMPS GIVE 2½ TIMES THE LIGHT OF ORDINARY FLUORESCENTS

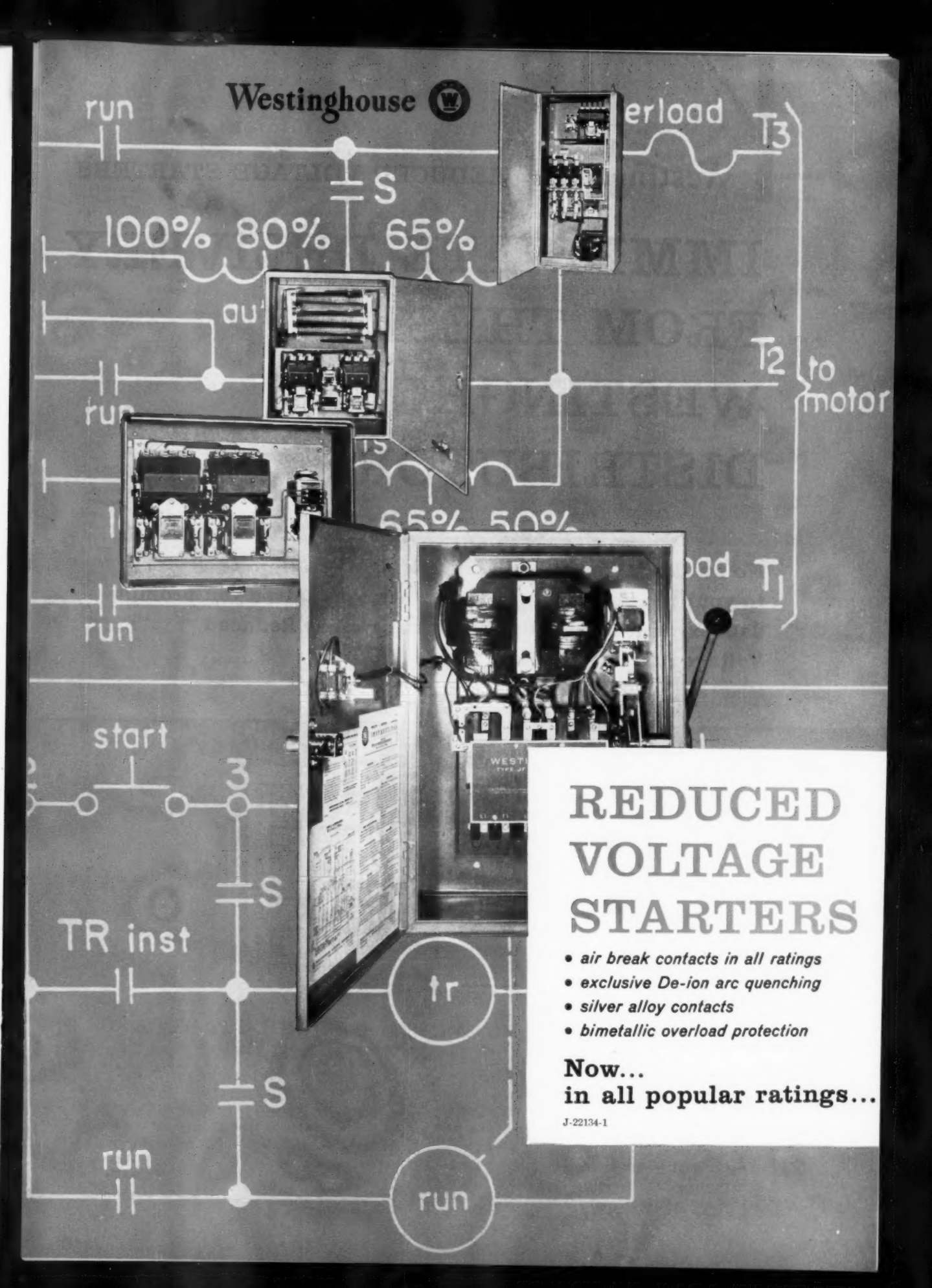


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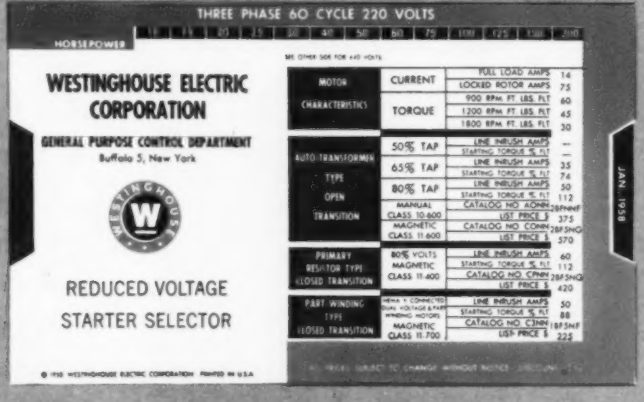
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EXport 4-2691

SALT LAKE CITY
Westinghouse Electric Supply Co.
210 Rio Grande Street
DAvis 2-2441

VIRGINIA

HARRISONBURG
Tristate Electrical Supply Co., Inc.
4-7514

RICHMOND
Westinghouse Electric Supply Co.
511 East Byrd Street MI 3-0111

ROANOKE
Westinghouse Electric Supply Co.
732 First Street, S.E.
Diamond 4-3271

WASHINGTON

SEATTLE 4
Westinghouse Electric Supply Co.
1051 First Avenue, South MAin 3-7001

SPOKANE
Westinghouse Electric Supply Co.
N. 1023 Monroe Street FA 8-3371

TACOMA 2
Westinghouse Electric Supply Co.
1325 South Tacoma Way GR 4-9476

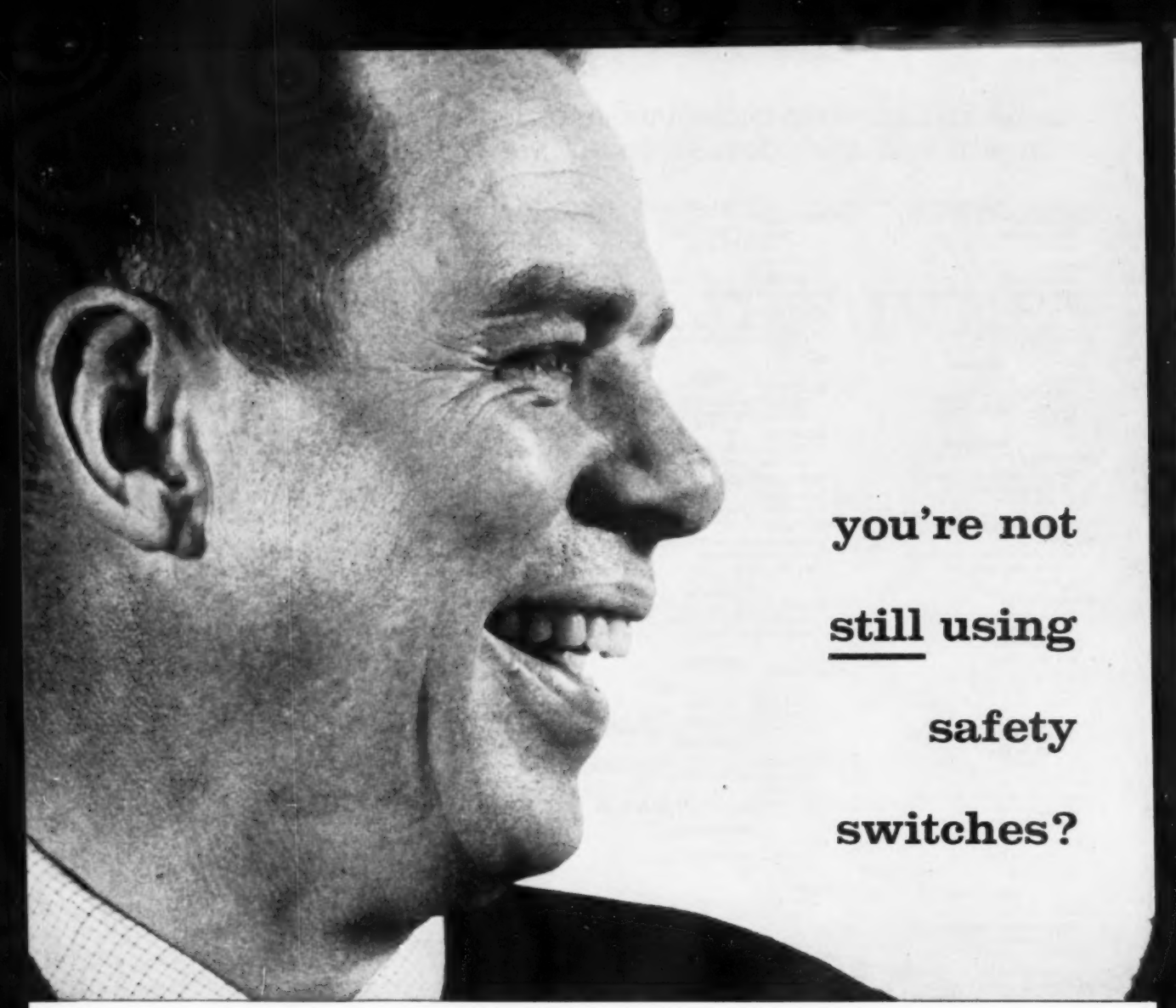
WISCONSIN

GREEN BAY
Westinghouse Electric Supply Co.
619 Main Street HEmlock 5-3751

MADISON
Westinghouse Electric Supply Co.
110 North Thornton Avenue
AL 5-4867

MILWAUKEE
Westinghouse Electric Supply Co., Inc.
1600 W. Cornell LO 2-8904

J-22134-3



you're not
still using
safety
switches?

but if you are,
be sure to read these
facts from
Westinghouse...



Safety switches versus AB-I breakers is an old, old controversy. Westinghouse manufactures both at their Beaver, Pennsylvania plant.

Here's their authoritative, unbiased report in the interest of better circuit protection:

Fact: AB-I's cost less. In most all motor applications, AB-I's are lower priced than an equivalent safety switch equipped with fuse. (For a rating-by-rating cost comparison, write to the Westinghouse address shown below.)

Fact: AB-I's require less mounting space. To protect a given motor size, the AB-I breaker will nearly always be smaller (up to 40% smaller, never larger) than an equivalent safety switch.

Fact: AB-I's require no maintenance. No costly fuses to replace; no production time-loss due to fuse replacements; no maintenance of any kind!

Fact: AB-I's are safer. With breaker protection, motors can't single-phase. There are no exposed live parts on an AB-I breaker to endanger workmen; no need to open the cover to reset the handle; no dangerous fuse replacements.

Fact: AB-I's are more versatile. Only with AB-I breakers can you use convenient, time- and money-saving accessories such as bell alarms, shunt-trips, auxiliary interlocks, etc.

It's a fact. AB-I breakers are the safest, surest, least costly means of circuit protection. On your next order, order the best in AB-I breakers—by Westinghouse.

J-30292

YOU CAN BE SURE...IF IT'S

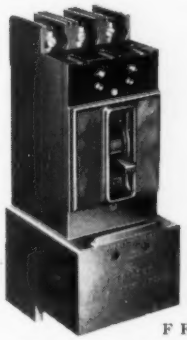
Westinghouse

Westinghouse Electric Corporation
STANDARD CONTROL DIVISION
Beaver, Pennsylvania



TRI-PAC

Westinghouse Tri-Pac Breakers
New Boss of 100,000 Amps



F Frame



LM Frame



K Frame



KL Frame

AVAILABLE NOW-
15 TO 600 AMPS

TRI-PAC— is the new kind of Westinghouse circuit breaker that handles 100,000-amp fault currents with ease.

TRI-PAC— is a triple-package of circuit protection—it combines the advantages of thermal and magnetic trips (for overloads and moderate faults) with current limiters to handle high-value short circuits.

TRI-PAC— is the smallest protective device you can apply where 100,000 amps can be poured into faults—for example, in network systems and those fed by large transformers.

TRI-PAC— is far less expensive than equivalent air circuit breakers—far safer and more convenient than switches combined with fusible elements.

TRI-PAC— is available now, in 100-, 225-, 400- and 600-amp frame sizes — all with 100,000-amp interrupting ratings.

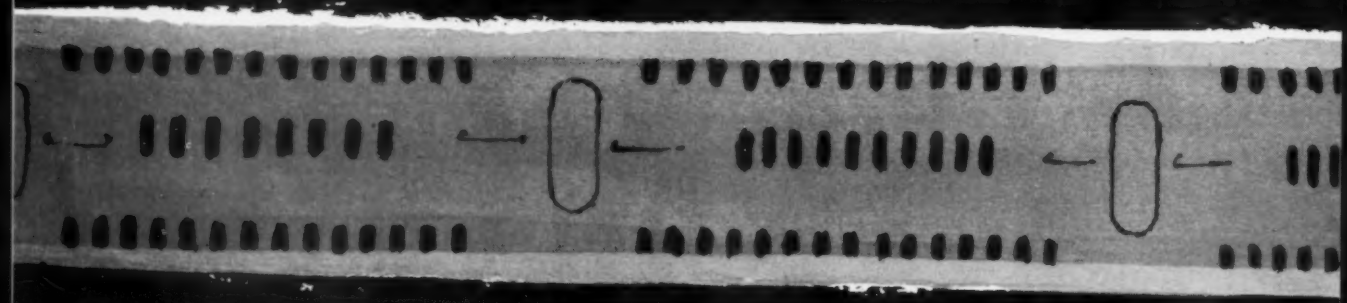
For details on the easy application and low cost of TRI-PAC*, please contact your nearby Westinghouse sales office, or write to the Westinghouse address shown below for copies of Application Data Bulletin 29-161 and Descriptive Bulletin 29-151. J-30294

*Trade-Mark

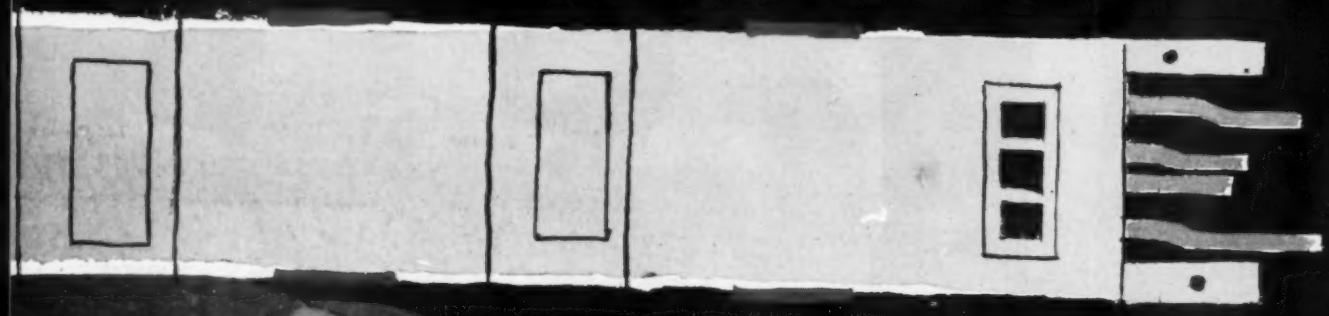
YOU CAN BE **SURE**...IF IT'S
Westinghouse

Westinghouse Electric Corporation
STANDARD CONTROL DIVISION
Beaver, Pennsylvania





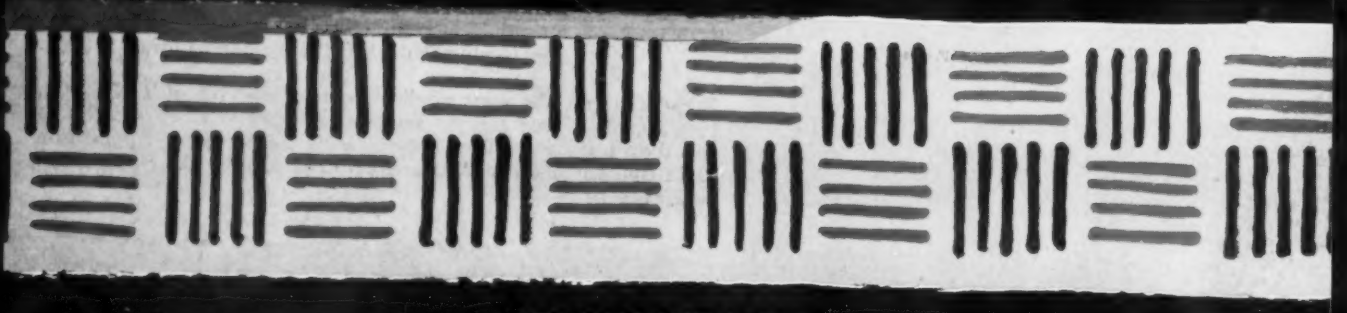
LIFE-LINE BUSWAY



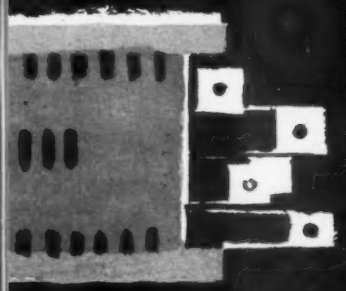
PLUG-IN



CONVENTIONAL WEATHERPROOF



LOW-IMPEDANCE



Only from Westinghouse

The Right Type of Bus Duct for Every Bus Duct Job

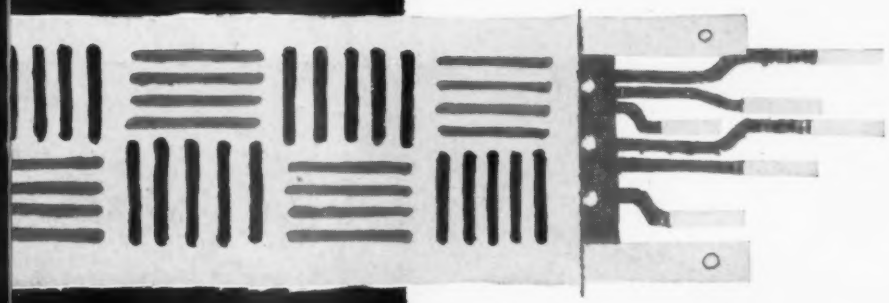
Because of the unmatched variety of bus duct he can offer, only your Westinghouse application engineer can give you unbiased assistance on the bus duct installation you're planning. He'll show you how Westinghouse can tailor-make the right system for your application—and at a minimum cost.

Westinghouse (*only* Westinghouse) offers you all this bus duct—tailor-made for every secondary power distribution job. There's Plug-In Duct; Low-Impedance; Life-Line® Busway; and Conventional Weatherproof. There's a type for long runs or short runs; with or without plug-in openings; totally enclosed or ventilated; indoor or outdoor.

Besides, with Westinghouse bus duct you get *all* of the advantages of bus duct over cable and conduit. It costs less to install, less to maintain, less to rearrange; it's safer for workmen, easier to stock and handle, and every foot is reusable.

Your local Westinghouse application engineer or distributor is the man to talk to. Phone him today! Or write: Westinghouse Electric Corporation, Standard Control Division, Beaver, Pennsylvania.

J-30297



Westinghouse Electric Corporation
STANDARD CONTROL DIVISION
Beaver, Pennsylvania



YOU CAN BE SURE...IF IT'S

Westinghouse

ANOTHER IN A SERIES
OF MOTOR FACTS
FROM ALL INDUSTRIES

Westinghouse Life-Line A motors helped save $13,500 in olive pitting operation . . .

at Bell Packing Corporation, Berkeley, California

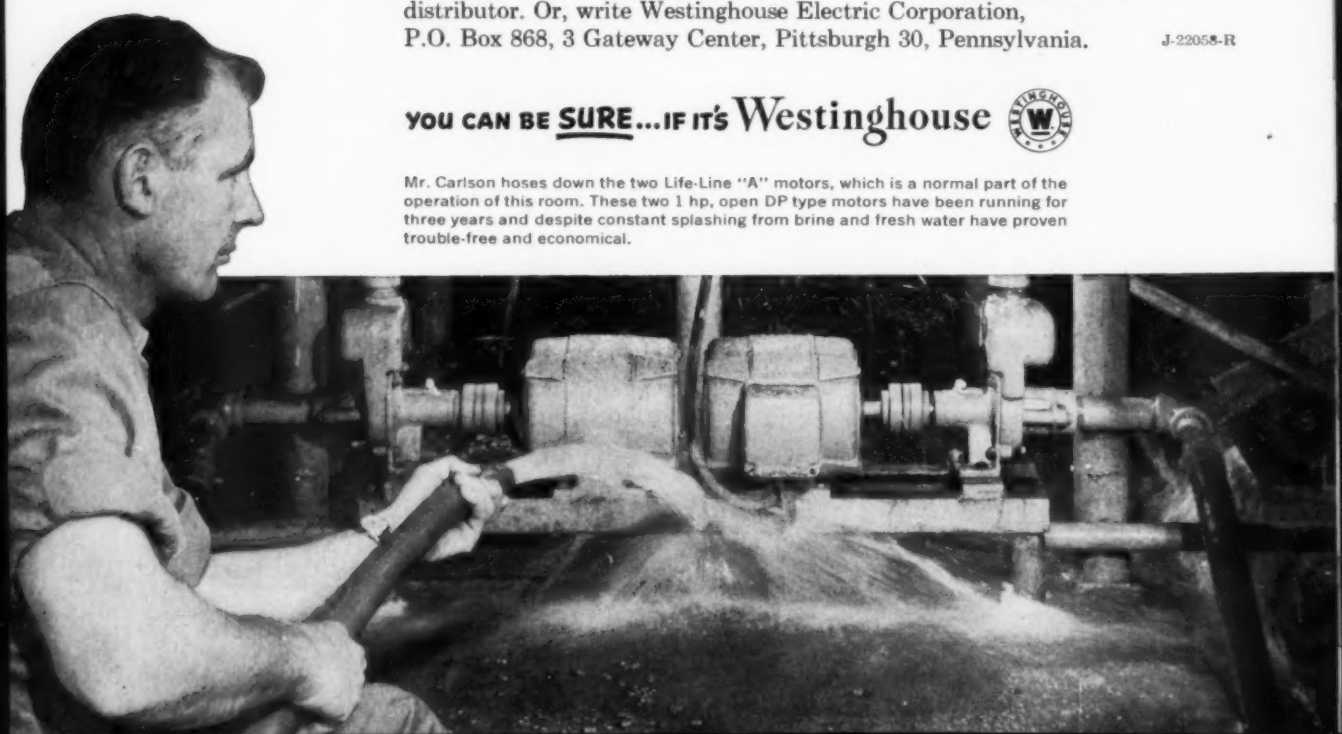
Continuously driving brine pumps for olive-pitting operation, Westinghouse motors have helped cut production costs, improved product quality

"Westinghouse Life-Line® 'A' motors make possible the profitable functioning of the new pitting room in our olive canning plant," states Mr. William Carlson, Plant Superintendent at Bell Packing Corporation, Berkeley, California.

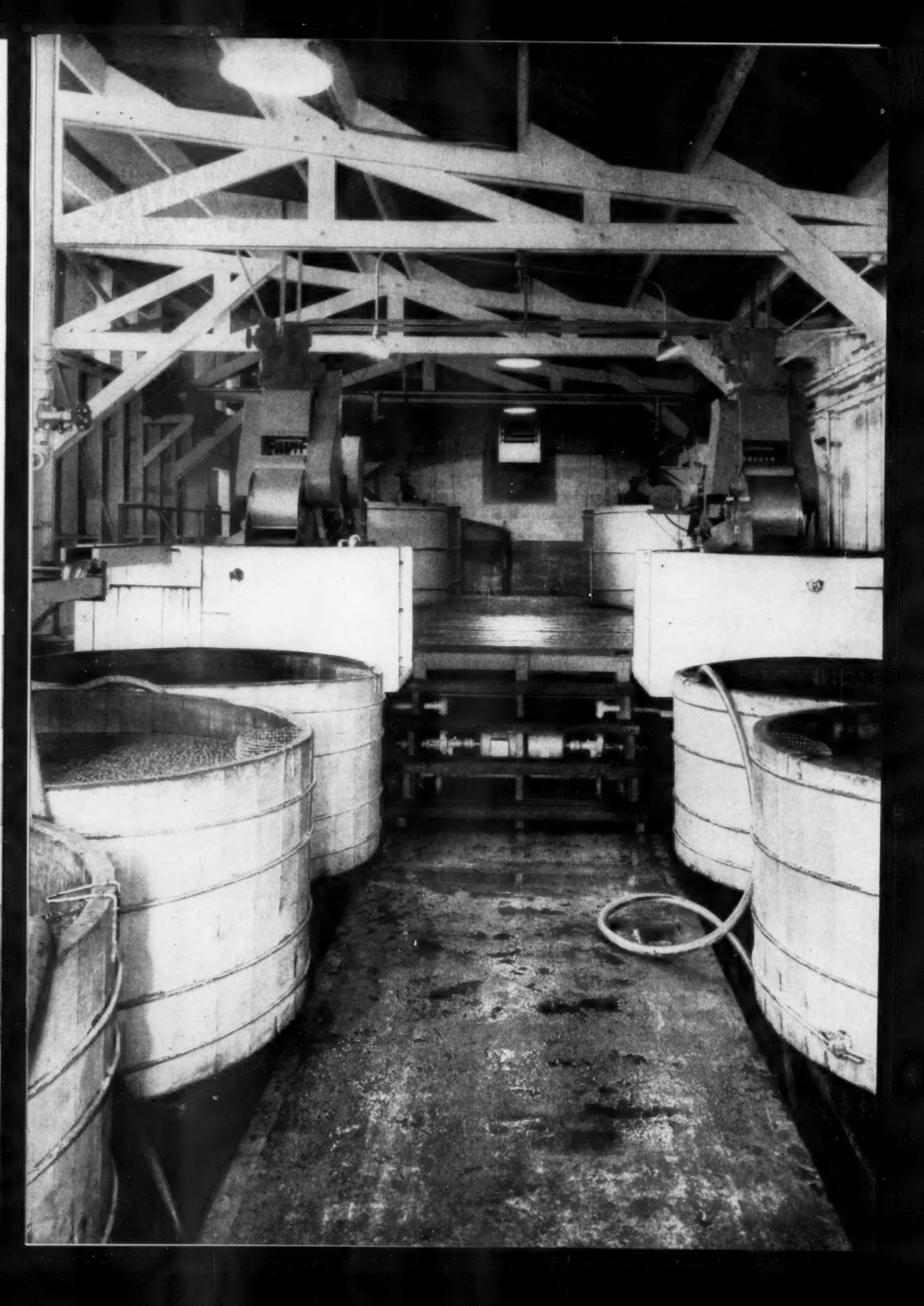
Mechanizing this operation has increased production 15% and released a good share of the normally required manpower for use elsewhere in the plant. In three years, Bell Packing reports a saving of $13,500. In designing the area, Bell Packing Corporation considered the choice of motors for the brine pumps the most serious problem. Westinghouse 1 hp Life-Line "A" motors were chosen on their record of long-term, trouble-free life under the toughest conditions.

POWER-UP with the motor designed to meet modern industry's needs. For complete information, call your Westinghouse sales engineer or distributor. Or, write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pennsylvania. J-22058-R

YOU CAN BE SURE...IF IT'S Westinghouse

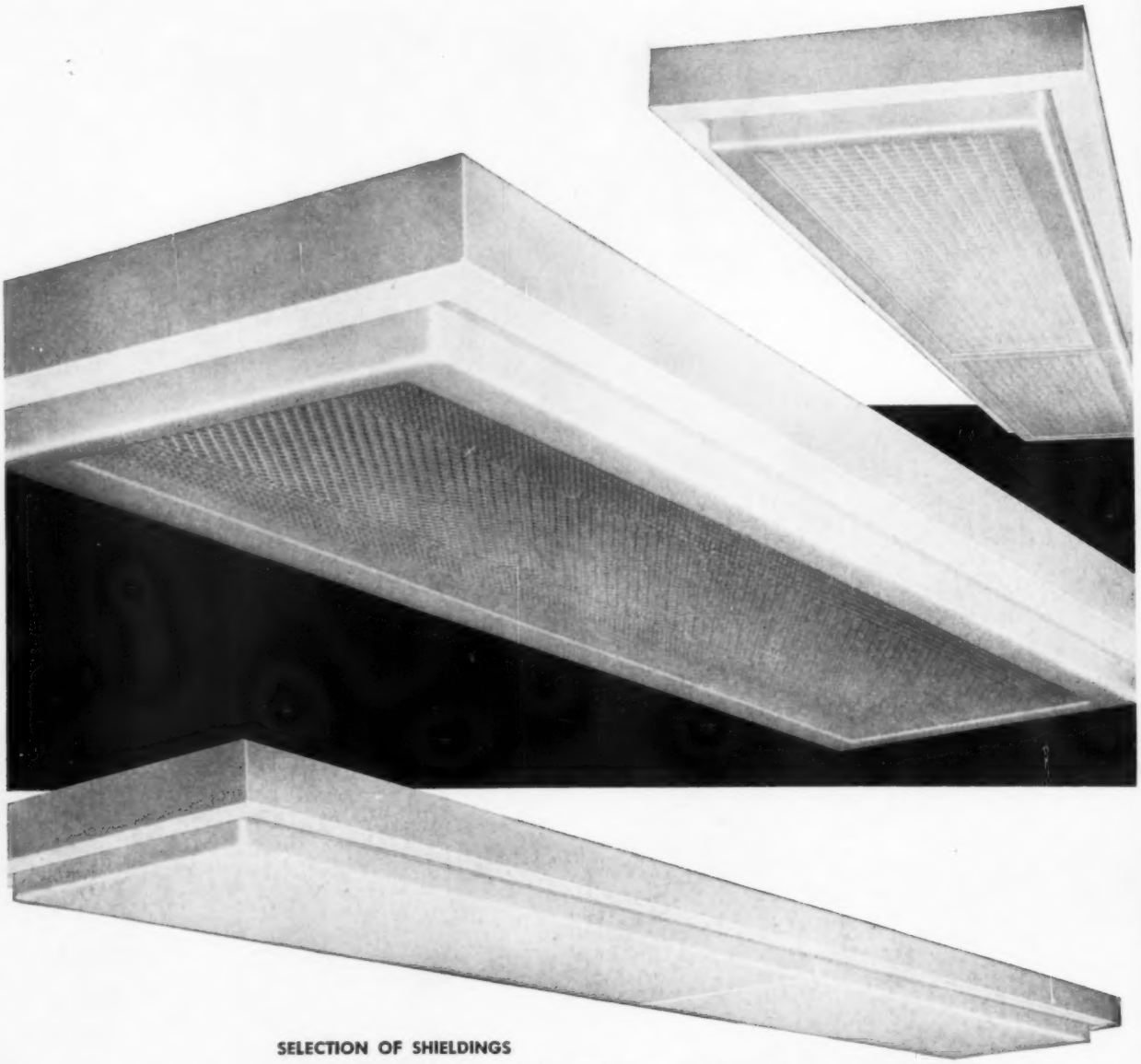


Mr. Carlson hoses down the two Life-Line "A" motors, which is a normal part of the operation of this room. These two 1 hp, open DP type motors have been running for three years and despite constant splashing from brine and fresh water have proven trouble-free and economical.



NEW from Westinghouse

SURFLINERS



SELECTION OF SHIELDINGS

SURFLINERS offer the preferred plain, dished-plastic shields—45° clear, open louvers in plastic—popular Opti-Kube lenses—or the high-quality Holophane 6018 lens. 2⅜-inch SURFLINER housings plus "deepest" shields still total less than 3 9/16 inches. Decorative end-covers come complete with self-tapping screws.

Thinner! Wider! Mass-Produced!

DESIGN-ENGINEERED TO DELIVER FULL BALLAST LIFE!

Now you can have a high-quality luminaire at low cost that eliminates the usual problems of ballast overheating!

It is the new Westinghouse SURFLINER. It is ideal for *any* surface-mounting installation! And it provides every feature—in one style of unit—that contractors have said they want in a commercial luminaire!

For example: SURFLINERS offer two—three—or four lamps—all in the same style unit! Therefore, they deliver just the amount of light you want for stores, offices, schools, public buildings!

SURFLINER housings are only 2⅜ inches deep—have "part-of-the-ceiling" appearance! Moreover, their clean, simple lines—in lengths of 4 feet or 8 feet, and in the new 16½-inch width—were decided by architects to have the best proportions today for modern ceilings!

SURFLINERS have *unique, all-luminous* "basket" doors —which support your choice of shieldings—provide uniform, glare-free diffusion! And maximum lighting quality!

What's more, these new SURFLINERS take ballasts away from the critical heat-chamber area—actually prolong ballast life and lamp efficiency!

The ballasts in SURFLINERS are *not* located between the lamps—where serious overheating can drastically cut ballast life! Instead, they are off to one side and shielded by the reflector! SURFLINER CHM ballasts stay cooler—maintain operation within proper, prescribed standards!

See, below, how SURFLINERS cut installation costs!



Fast, Simple Installation! Delivery Now!

SURFLINER housings are light in weight and rib-reinforced for easier handling. Convenient rip-open cartons contain one housing or two doors. Precision knockouts make faster mounting and easier bolting together of units in continuous rows. Accessory end-plates are available but not necessary.

Entire SURFLINER units are pre-assembled and pre-wired. Either-end lead wires save wiring time and materials. "Basket" doors contain their own concealed, but clearly marked, latch-and-hinge arrangement—merely "snap" securely shut.

SURFLINER maintenance is negligible! Sturdy, full ⅛-inch styrene "basket" doors swing free at a gentle push. Forty-watt rapid start or slimline lamps are quickly changed. Specially finished reflectors wipe clean. Are quickly removed or replaced for ballast and wiring inspection. Even the socket support-plates are screwed out. No more housings need be taken down for socket replacement!

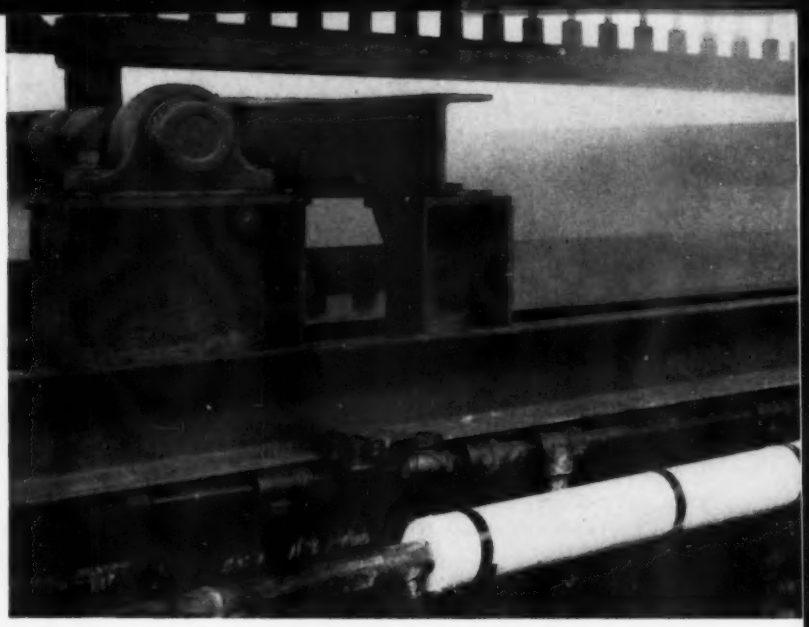
Call your Westinghouse Distributor—TODAY! Or, write to Westinghouse Electric Corporation, LIGHTING DIVISION, Edgewater Park, Cleveland, Ohio, RIGHT AWAY! J-04452

YOU CAN BE SURE...IF IT'S

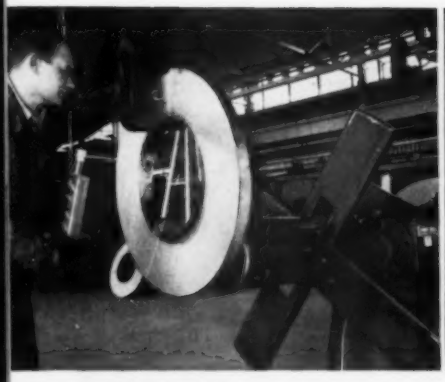
Westinghouse

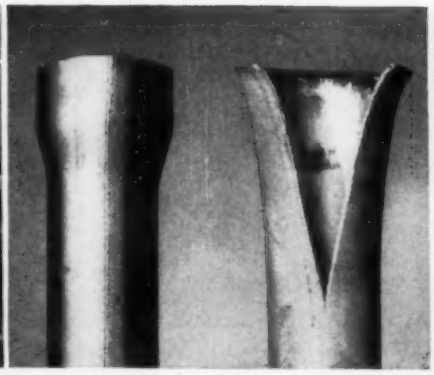
Certified Lighting





NEWS! Now Circle's







Proper steel plus!

The best cold rolled steel, unless properly fabricated and finished, will lose its ductile properties. Circle processes are designed to retain the natural bendability of the selected high grade steels it uses for CIRTUBE EMT.

Better welding makes a difference!

Note how ordinary EMT split early in pressure test while induction welded CIRTUBE EMT held fast, surpassing minimum UL requirements. High frequency induction welding not only means bead-free welds for easier fishing—but stronger tube as well.

The fishability is all in the finish!

You need more than a slick surface to make wire pulling easy. You also need a sort of built-in lubrication. A baked-on protective coating containing special wax-like ingredients gives CIRTUBE EMT this property.

Lifetime exterior finish!

No matter how severe the bends, there's no chip, no flake, no peel. The galvanized finish is hard for durability; has a polished satin lustre for lasting good looks. A completely automatic, electronically controlled process guarantees this uniform protection.

Automated quality control!

Very little has been left to human error in the manufacturing control of CIRTUBE EMT. Wherever possible, completely automatic controls have been built into equipment to assure contractors complete and continuing uniformity of product.

Tight, easily handled bundles!

Circle has automated every possible operation to make your job easier. Bundling, for example, is completely automatic. Distinctive orange colored tapes identify CIRTUBE EMT, hold bundles securely together for easier handling on and off the job.









making CIRTUBE EMT

New plant, ultra modern equipment, special techniques combine to produce new CIRTUBE EMT — unsurpassed for quality and workability

IT TOOK well over two years of extensive research to develop CIRTUBE EMT *

First we surveyed the needs of the contracting industry. Then we investigated the latest manufacturing methods and techniques, examined available equipment and materials — even hired a famous consulting engineering firm to design special machines.

Behind all of this we put Circle's 37 years of know-how and skill developed in manufacturing a top quality line of building wire and cable.

PURPOSE: to produce EMT with the right combination of bendability, fishability, durability, and appearance.

The final result is CIRTUBE EMT — a quality electrical metallic tubing that permits contractors to make better, faster, more profitable wiring jobs.

CIRTUBE EMT is at your Circle wholesaler's now. Try it! You'll like working with it.

* T. M.

Fast, friendly service!

First with building wire and cable — and now with CIRTUBE EMT. Wholesalers and contractors are assured of the same fast, dependable service through Circle's nationwide network of 22 well-stocked warehouses.



CIRCLE WIRE & CABLE
a subsidiary of
CERRO DE PASCO CORPORATION

PLANTS: Maspeth and Hicksville, N. Y. **SALES OFFICES & WAREHOUSES:** in all principal cities

RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES
NEOPRENE SHEATHED CABLES • "CIRTUBE" EMT

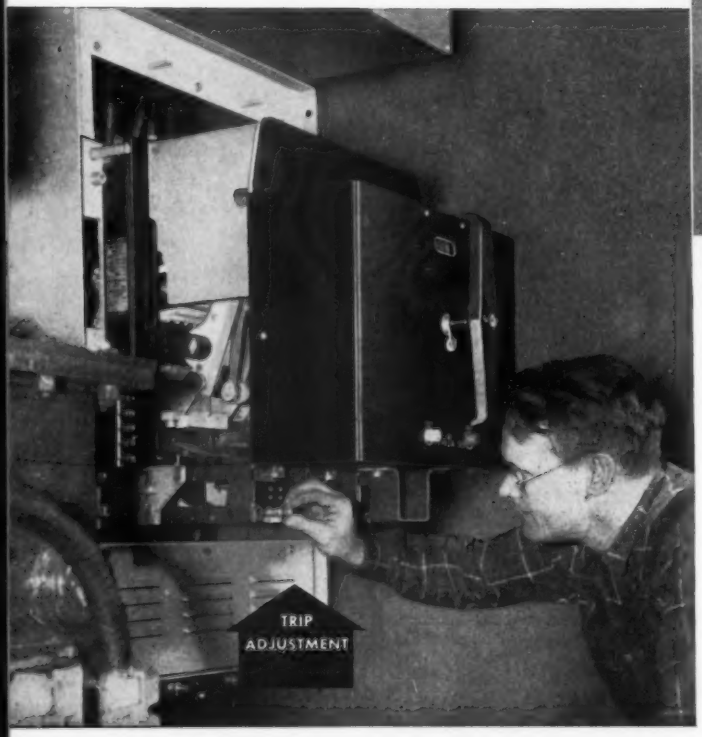
CIRTUBE EMT *Ask for it!*



ALLIS-CHALMERS
individually enclosed LOW VOLTAGE BREAKERS

Deep removable cover





simplifies breaker inspection . . . adjustments

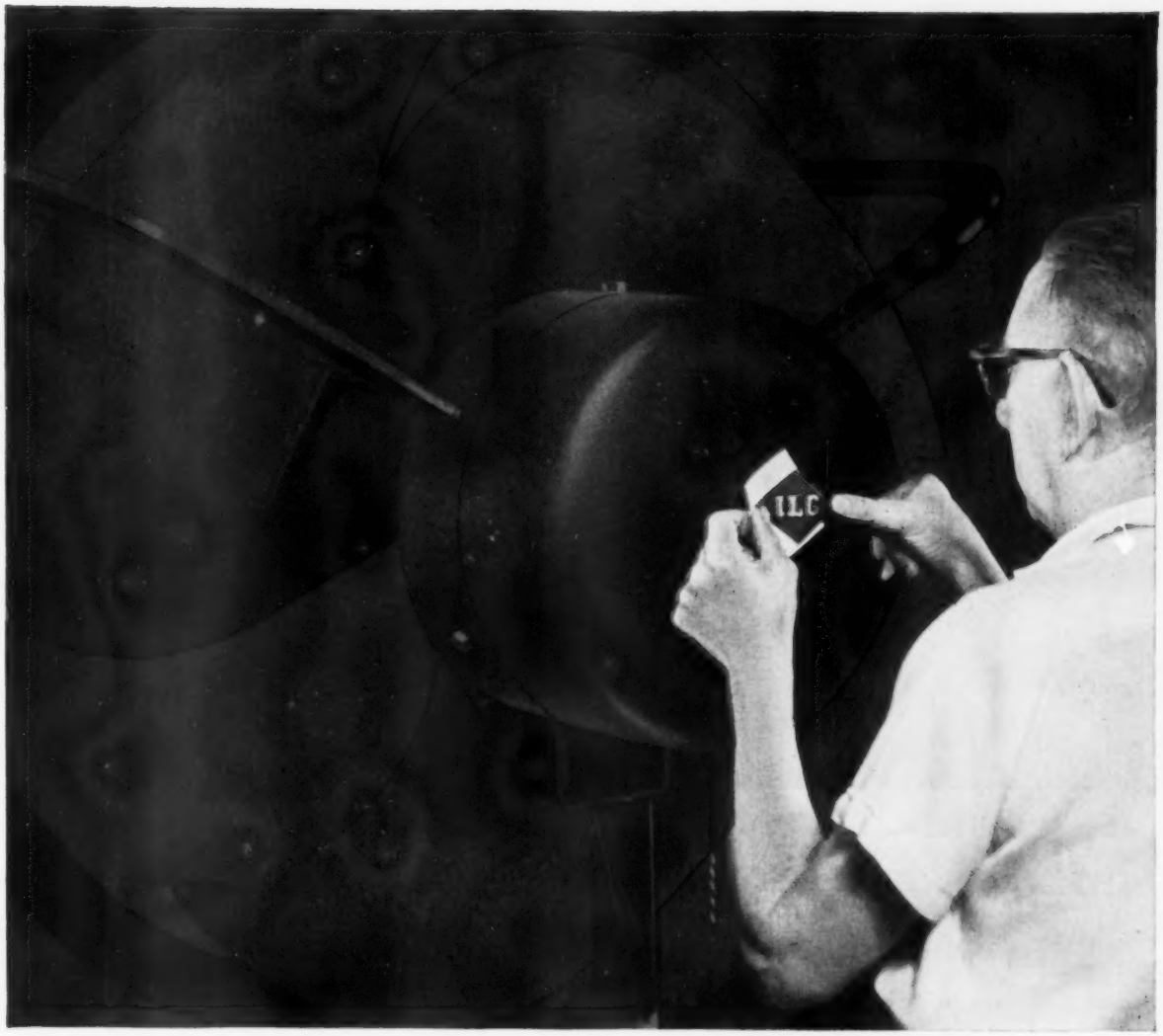
For fast, complete breaker inspection, use Allis-Chalmers individually enclosed low voltage breakers. Removing only the cover, instead of the entire breaker, provides full, easy access from all angles.

Easy installation, inspection, and operation are yours with Allis-Chalmers breakers. Get complete details. Call your nearby A-C distributor or office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5565



at his finger tips (and yours)...

this guarantee of trouble-free performance

Put in ILG Propeller Fans — with this "One-Name-Plate" guarantee—and you get performance that pays off at all levels.

Maintenance, for example, is no problem. Ilg-built self-cooled, permanently lubricated motors never run hot, have no internal starting switch to wear out, last longer.

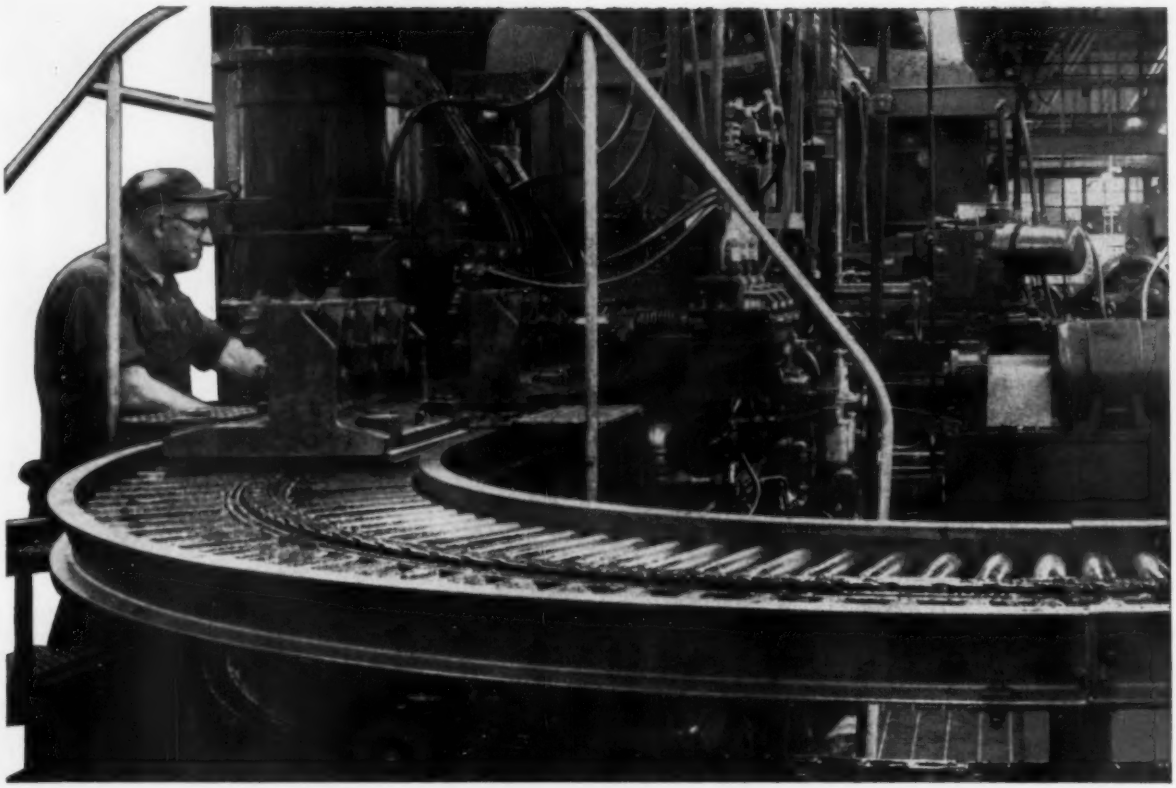
Operating Costs? Low. Ilg self-cooled motors offer the cost advantages of open-type motors . . . protection superior to totally enclosed motors . . . *save as much as 10% on power costs.*

Quiet Operation? Right! Direct-connected Ilg fans eliminate noise, slippage and friction of belts and pulleys. Patented-design, dynamically balanced fan wheels cut vibration and noise to the minimum.

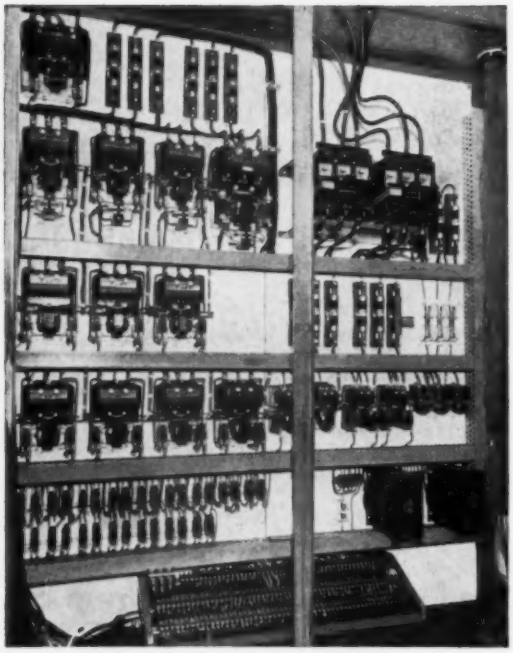
And should you need any further service once an Ilg fan is in, you merely call your nearest Ilg office. One call brings prompt action . . . puts real meaning into our "One-Name-Plate" pledge of superior performance.

ILG

ILG ELECTRIC VENTILATING CO.
2879 N. Pulaski Road, Chicago 41, Ill.
Offices in 57 Principal Cities



Eaton Manufacturing Company automation line depends on CLARK Type "CY" Starters to minimize costly downtime...



In complex automatic machines used today, dependable electrical controls are essential to continuous operation.

Typical of such machines is this automation line at the Pump Division of Eaton Manufacturing Company in Marshall, Michigan. Designed and built by the Avey Division of The Motch & Merryweather Machinery Co., it performs 132 operations on automatic power steering pump bodies. The control system contains 15 Clark type "CY" starters, in sizes from 1 to 3, designed for dependable, heavy-duty, long-life operation.

Every panel component is a vital link in the production process. Because Clark Type "CY" starters employ an exclusive principle of arc-quenching, using double-break contacts and strong, multi-turn magnetic blowouts, contact life is greatly increased. Throughout industry, thousands of Clark starters are giving on-the-job proof that this means less maintenance, reduced downtime, and increased production and profit.

To assure complete dependability for the control of this machine, Clark space-saving Type "PM" relays are used for the hundreds of complex circuit switching functions required.

For information on dependable Clark Control, contact your nearest Clark Distributor or write us direct.

The **CLARK CONTROLLER** *Co.*

Everything Under Control • 1146 East 152nd Street • Cleveland 10, Ohio

IN CANADA: CANADIAN CONTROLLERS, LIMITED • MAIN OFFICES AND PLANT, TORONTO



KOOL KOIL

FABULOUS NEW ADVANCE FLUORESCENT LAMP BALLAST . . .

guaranteed to operate 15 to 20 degrees cooler

up to 15% more light output . . . increases ballast life 3½ to 4 times

eliminates use of costly radiators

HERE'S THE PROOF —

ADVANCE TRANSFORMER CO. • 2950 NORTH WESTERN AVENUE • CHICAGO 18, ILLINOIS

Here's the KOOL KOIL PROOF

AVERAGE TEST DATA* IN 40 C. CBM AND UL HEAT BOX

BALLAST TESTED	MAXIMUM COIL TEMP. °C	MAXIMUM CASE TEMP. °C	WATTS LOSS	LAMPS WATTS (147 Standard)	PERCENTAGE OF LIGHT OUTPUT
ADVANCE CAT. NO. RSH-2E75-S	89°	74°	23	145	97.0
Ballast "A"	108.5°	86°	26.5	139	93.2
Ballast "B"	105°	87°	28.5	137	89.8

AVERAGE TEST DATA* — REPRESENTATIVE FIXTURES

METAL SIDES AND PLASTIC DIFFUSER — 4-LAMP SURFACE MOUNTED

ADVANCE CAT. NO. RSH-2E75-S	100.5°	87°	23.5	122.5	82.2
Ballast "A"	124°	103°	25	111.0	74.5
Ballast "B"	117°	102°	27	108.0	72.5

DROPPED PLASTIC SIDES — GLASS BOTTOM — 4-LAMP SURFACE MOUNTED

ADVANCE CAT. NO. RSH-2E75-S	102°	89°	24	118	79.0
Ballast "A"	127°	105°	25	107	71.9
Ballast "B"	119°	104°	27	104	69.8

GLASS BOTTOM — 6-LAMP RECESSED TROFFER

ADVANCE CAT. NO. RSH-2E75-S	91°	76°	22	115	77.2
Ballast "A"	113°	91°	23	105	70.4
Ballast "B"	105°	94.5°	25	102	68.3

GLASS BOTTOM — 4-LAMP RECESSED TROFFER

ADVANCE CAT. NO. RSH-2E75-S	99°	86°	22	111	74.5
Ballast "A"	120°	101°	24	104	69.8
Ballast "B"	117°	102°	27	100	67.3

*TEST DATA COMPUTED WITH CERTIFIED (CBM) BALLASTS AND (2)F96T12 LAMPS.

The new ADVANCE KOOL KOIL Fluorescent Lamp Ballast is the greatest forward step in the history of fluorescent lighting . . . IT SOLVES THE HEAT PROBLEM!

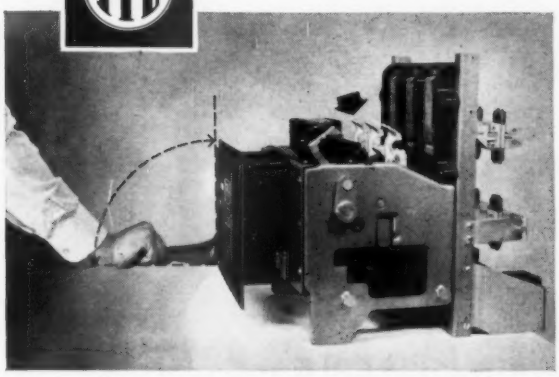
This ADVANCEment required three years of exhaustive research, development and testing new grades of steel, wire, insulation and compounds. As a result, ADVANCE now brings the lighting industry the new KOOL KOIL series-sequence ballast that operates 15 to 20 degrees cooler, gives 15% more light output and increases ballast life 3½ to 4 times.

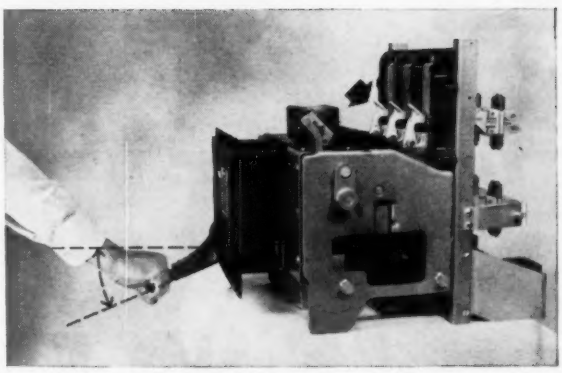
TECHNICAL DATA—ADVANCE KOOL KOIL BALLAST—CAT. No. RSH-2E75-S

CATALOG NUMBER	LAMP TYPE	NOMINAL LAMP WATTS	RATED LAMP CIRCUIT M.A.	CIRCUIT VOLTAGE	LINE CURRENT (AMPS)	WATTS LOSS	OPEN CIRCUIT VOLTAGE	DIMENSIONS IN INCHES			
								LENGTH	WIDTH	HEIGHT	MOUNTING
RSH-2E75-S	(2)F96T12	74	430	118	1.5	24	775	14 5/16"	3 7/64"	1 25/32"	13 3/4"
	(2)F72T12	55	430	118	1.5	24	775	14 5/16"	3 7/64"	1 25/32"	13 3/4"

ADVANCE TRANSFORMER CO. • 2950 NORTH WESTERN AVENUE • CHICAGO 18, ILLINOIS

K-LINE LOW VOLTAGE SWITCHGEAR





Only I-T-E has manual quick-make operation available in 225 through 1600 amp rating

Only handle moves. Contacts are static during first 90% of pulldown handle travel. In this picture, arc chutes are removed.

Too fast for the eye. When stored energy mechanism passes crossover point, energy is released to close contacts within 5 cycles.







Only I-T-E has doors closed in all positions while racking

With breaker connected. Both power and control separable contacts are engaged.

In test position. Power contacts disconnected —control contacts connected.

Completely disconnected. Both power and control contacts fully disconnected.

Quick-make, manually charged closing feature and drawout with doors closed provide maximum safety for operator and circuit breaker

You can't tease and burn the contacts of the new quick-make K-Line of circuit breakers—the closing action is fast and positive. An ingenious stored energy mechanism does the job. It stores energy in the first 90% of the pulldown handle travel, releases it in the last 10%. Not until the crossover point is reached do the contacts move. And it closes in only 5 cycles—provides uniform closure every time. *More important, it is the only manually charged stored energy circuit breaker available that will close and latch against its short-time rating.* This means greater safety for the operator, less maintenance, and longer contact life.

You don't have to open the door to move the circuit breaker to test or disconnected position. The crank which operates the simple drawout mechanism fits into the escutcheon through a lift shutter. The shutter cannot be lifted while the breaker is closed. The breaker cannot be closed while the shutter is lifted. This means more than greater safety—you can forget the dirt problem; the nuisance of open doors impeding aisle travel; the risk of circuit breaker damage from exposure, even when completely out of service.

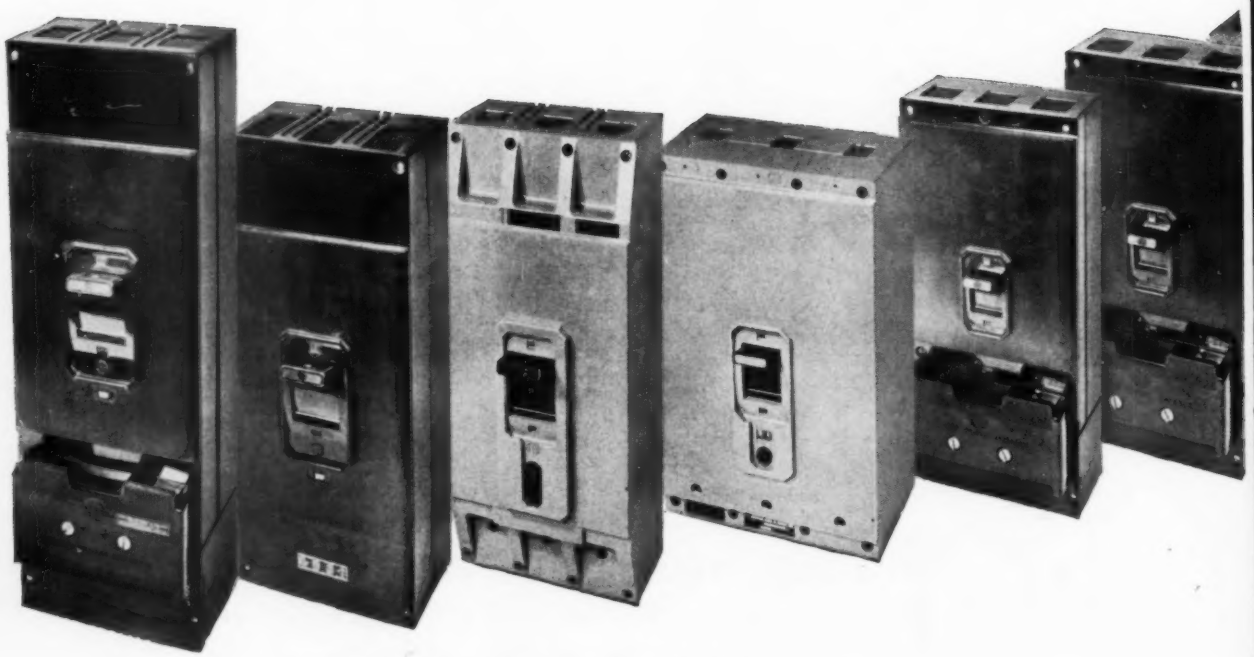
Bulletin 6004-C gives complete information about the new and safer I-T-E K-Line of low voltage switchgear. Contact your nearest I-T-E sales office for a copy. Or write Switchgear Division, I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.

I-T-E CIRCUIT BREAKER COMPANY
PHILADELPHIA, PENNSYLVANIA

MOLDED CASE CIRCUIT BREAKERS

YOU GET "EXTRA QUALITY —AT NO EXTRA COST"

in Industry's Most Complete and Diversified Line





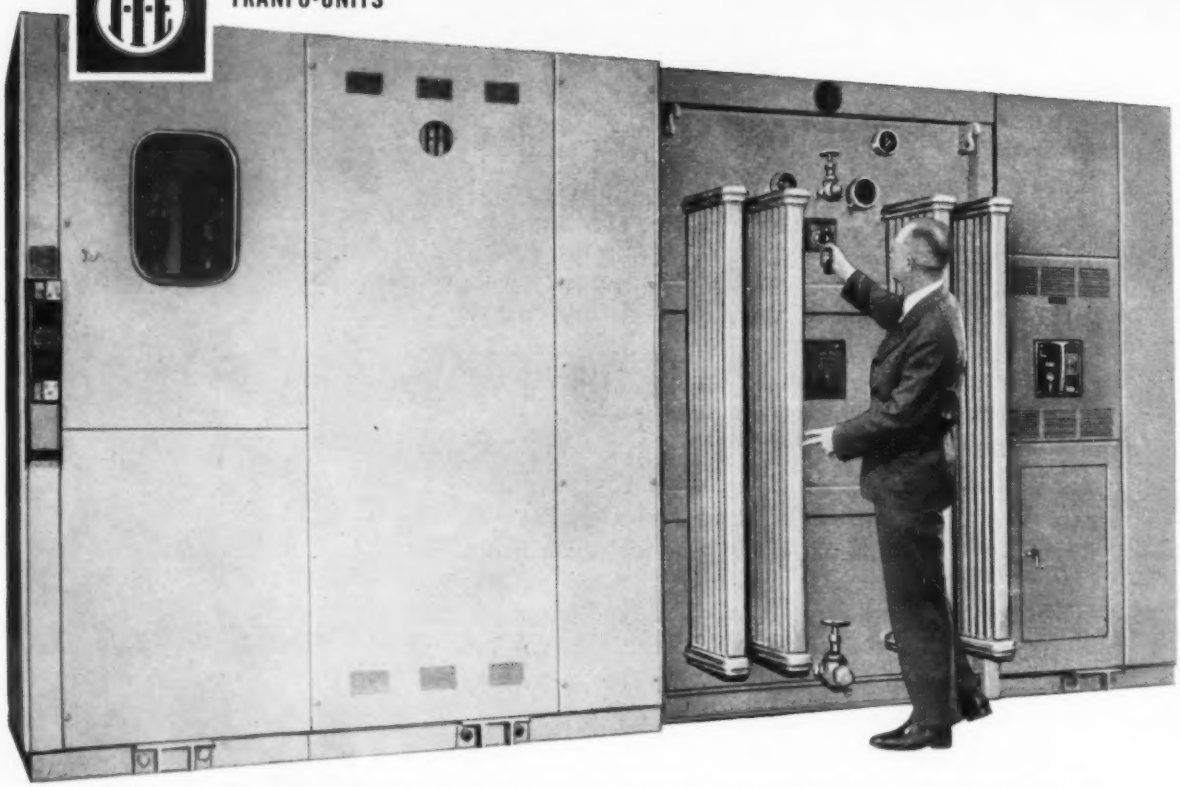
From the smallest circuit breakers for lighting circuit protection, through I-T-E's exclusive Cordons—with 100,000 amp interrupting capacities—to the many special-purpose breakers, such as the 400 cycle, 1000 v selective trip breaker designed for Navy use, I-T-E molded case circuit breakers constitute industry's most complete line.

Not only is the I-T-E line the most complete and most diversified, but I-T-E's famed "extra quality—at no extra cost" is built into every product which bears the I-T-E label. And you can depend on the nation-wide network of I-T-E distributors and field engineers to give you second-to-none service. I-T-E Circuit Breaker Co., Small Air Circuit Breaker Division, 19th and Hamilton Streets, Philadelphia 30.

I-T-E CIRCUIT BREAKER COMPANY

PHILADELPHIA, PENNSYLVANIA

TRANFO-UNITS



Neat, compact and completely self-contained—a practical, economical way to bring in your electric power at low cost higher voltage.

COMBINES DISCONNECT, TRANSFORMER AND SECONDARY CIRCUIT BREAKERS

More compact than a substation . . . better looking than combinations of loose equipment, yet no more costly . . . here is everything you need in many applications to buy power at economical high voltages.

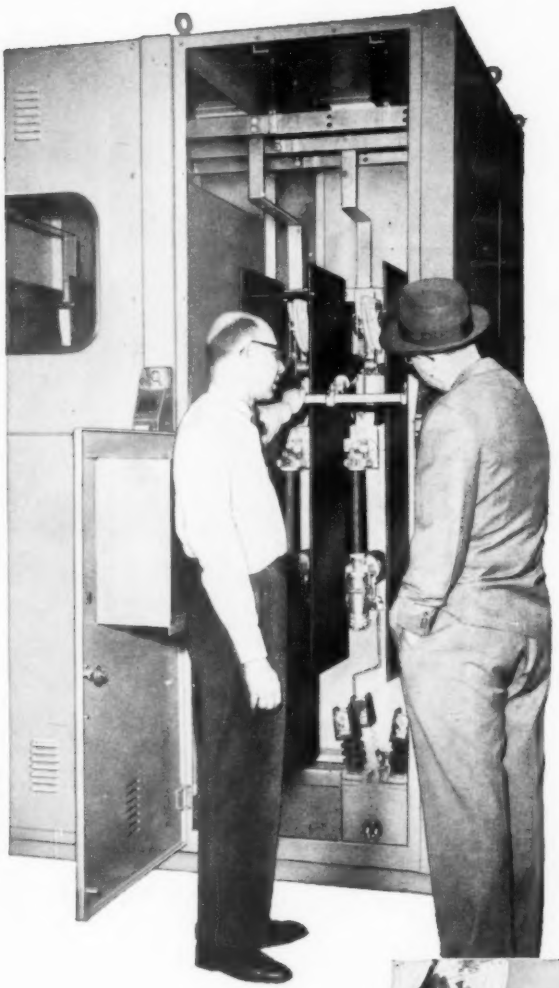
Every I-T-E Tranfo-Unit is completely assembled and wired at the factory, and no live parts are exposed to contact by personnel. It is normally shipped as a single package. But heavier units are split for easier handling. There is no complicated assembly at the site. You simply position it, connect it, and it's ready for operation. There is nothing else to buy—no additional engineering required.

For supermarkets, schools, office buildings, factories and many other power uses, the I-T-E Tranfo-Unit means new safety, new ease of installation, new improved appearance for power entrance equipment. Available in ratings from 45 through 3000 kva, primaries through 14.4 kv, secondaries through 600 v. For literature, write I-T-E Circuit Breaker Company, Transformer & Rectifier Division, 19th & Hamilton Sts., Philadelphia 30, Pa. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.

I-T-E CIRCUIT BREAKER COMPANY
PHILADELPHIA, PENNSYLVANIA

R&IE POWER SWITCHING CENTERS

"...and HPL-C switches close in on moderate faults"

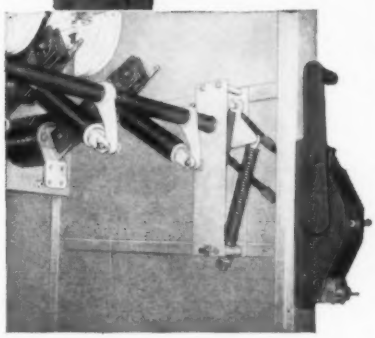


SAFE CLOSING RATINGS Asymmetrical 3-phase kva values

Nom. Voltage	Direct or Chain Drive	Tog-L Snap, non-current limit fuses	Tog-L Snap, current limit fuses
2,400	50,000	150,000	250,000
4,800	75,000	250,000	500,000
7,200	75,000	250,000	750,000
12,000	75,000	250,000	1,000,000
13,800	75,000	250,000	1,000,000

SAFETY FEATURES—(1) HPL-C closes in on special heavy closing contacts, outside the interrupter—thus preventing damage to the interrupter switch when closing in on moderate fault currents; (2) High velocity "Ovr-Centr" blade closing (and opening) with the Tog-L Snap operating mechanism—an optional feature, providing additional safety, important especially during the closing operation. For safety's sake, specify these important features.

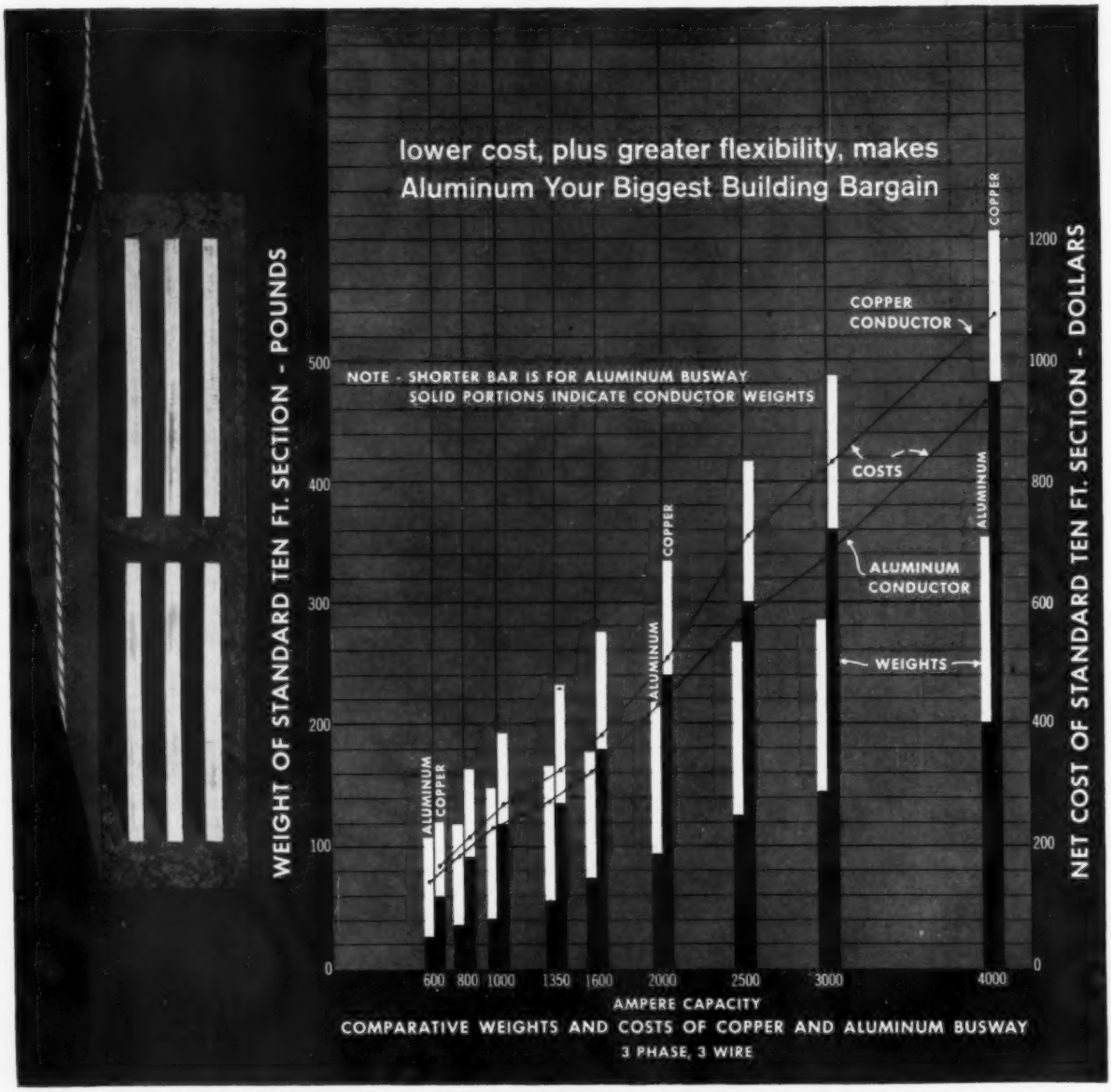
RATINGS—Fused HPL-C Interrupter Switches
up to 14.4 kv (110 bil)
600 amp (40,000 mom)
1200 amp (60,000 mom)



RIGHT—*Tog-L Snap operating mechanism, featuring "Ovr-Centr" spring actuator—optional, but important to safety in closing.*

TESTS—Switches have actually closed against moderate 3-phase fault currents at 4.8 and 13.8 kv—proving that the HPL-C offers a high degree of protection. Ask the I-T-E representative to give you the performance facts. See how you can save on installation costs with standardized engineering; on operating costs by preventing costly shutdowns; on maintenance costs through simple inspection and up-keep requirements and accessibility to equipment.

I-T-E CIRCUIT BREAKER COMPANY
R&IE EQUIPMENT DIVISION · Greensburg, Pa.



Aluminum Busway helps reverse trend to higher building costs

Comparison of initial cost of aluminum busway compared to copper shows aluminum has a price advantage, even in the smallest sizes.

Probably no other product used by the building industry can offer savings comparable to aluminum busway: up to 20% on material costs, up to 20% on installation costs and savings in weight permitting the use of less costly busway supports. Aluminum busway requires less space than cable and conduit.

Modern aluminum busway, with lightweight Alcoa® Aluminum Bus Bar, also offers flexibility to meet new and increased power demands. Future loads can be tapped off at any point. Pound for pound, aluminum busway has greater current-carrying capacity at less cost than conventional wiring systems.

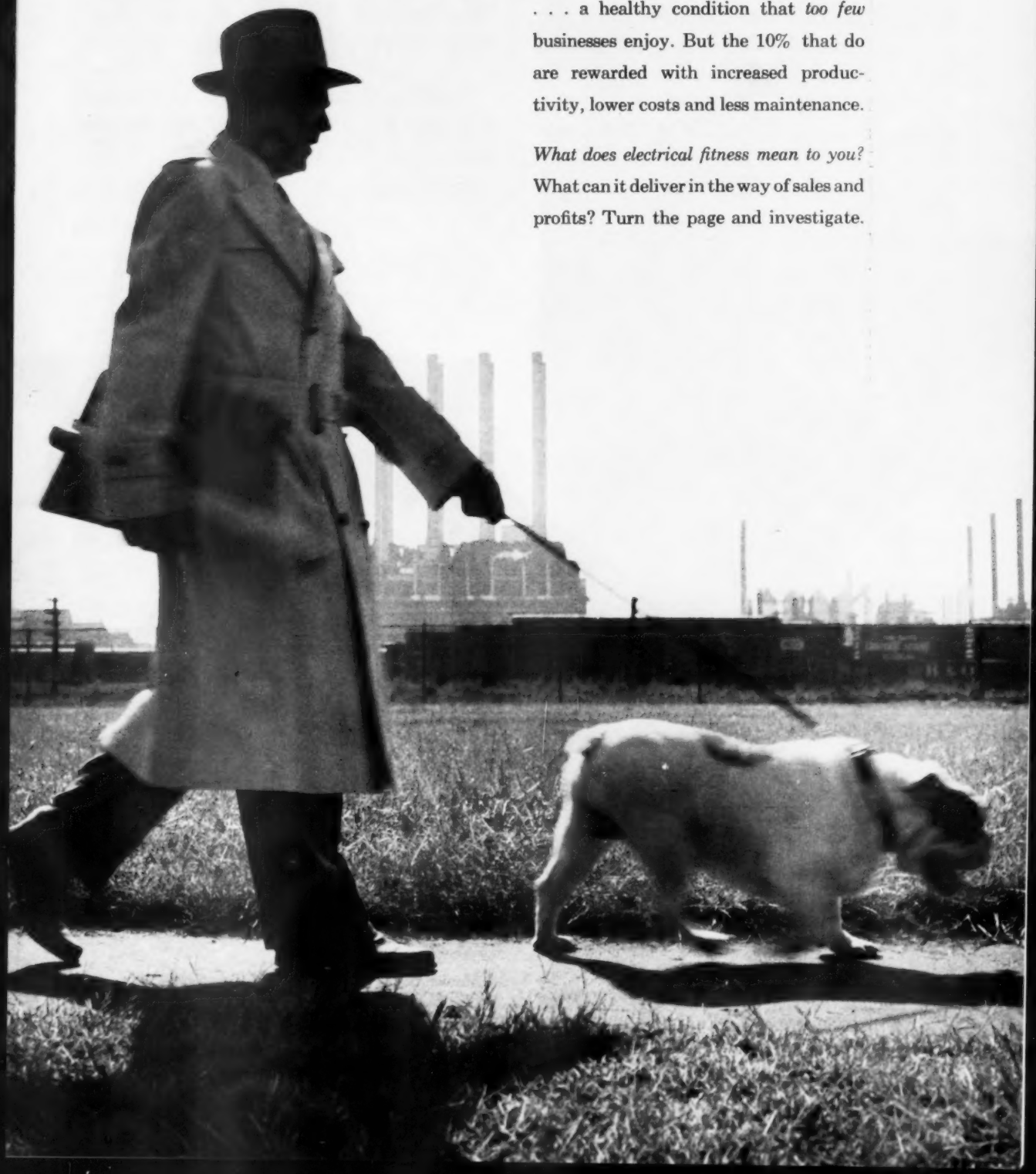
When *you* need a modern, flexible distribution system, specify busways made of Alcoa Aluminum . . . and *save*. Aluminum Company of America, 2302-E Alcoa Building, Pittsburgh 19, Pennsylvania.

Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM
ELECTRICAL CONDUCTORS AND ACCESSORIES
ALUMINUM COMPANY OF AMERICA

"ALCOA THEATRE"
Exciting Adventure
Alternate Monday Evenings

ELECTRICAL FITNESS



. . . a healthy condition that *too few* businesses enjoy. But the 10% that do are rewarded with increased productivity, lower costs and less maintenance.

What does electrical fitness mean to you? What can it deliver in the way of sales and profits? Turn the page and investigate.

What electrical fitness can do for you!

Find it difficult to excite prospects with terms like "adequate" wiring or "adequate" electrical distribution? Then sell them the modern, positive idea of *electrical fitness.* This is electrical distribution tailored to their present needs . . . but skillfully planned to expand or change quickly if these needs change. Electrical fitness strikes a responsive chord because it promises immediate electrical well-being . . . builds a sound foundation for long-range economy, flexibility and all 'round electrical good health.

On these pages are examples of *electrical fitness* the BullDog way. Read how it assures dollars and sense results.





Power on wheels...and on tap

BullDog Industrial Trol-E-Duct® brings *mobile* power to the production line . . . feeds trolleys that roll with the job—*or right to it!* New production units are powered by merely inserting new trolleys. Equipment works full time while production rolls smoothly.

Universal Lighting Duct® proves the easy answer to all lighting needs . . . can't be beaten for flexibility, either. Available in 20- and 50-amp capacity, Universal Duct both *feeds* and *supports* lights and small power tools. Fixtures twist in at any spot, can be moved and relocated in seconds. New 20-amp Lighting Duct requires no supplementary fusing. Both offer top lighting mobility at remarkably low cost.

BULLDOG



KROGER—CINCINNATI, OHIO

Safety is a certainty

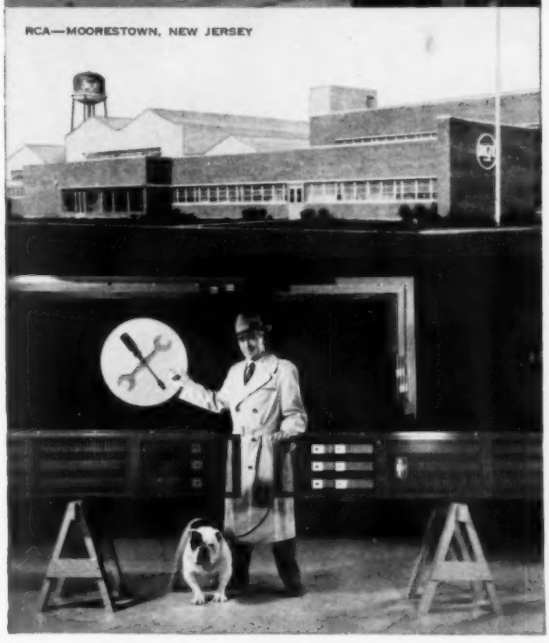
BullDog puts safety *first*. Duo-Guard Pushmatics® in Electri-Center® panels (pictured) provide *over-all* circuit protection . . . protect circuits *thermally* and magnetically. Unique Vacu-Break® arc control in BullDog Safety Switches smothers arcs instantly . . . minimizes burning and pitting. Another first, Clampmatic® control in BullDog switchboards, panelboards, safety switches and Vacu-Break bus plugs, brings bolt-tight electrical contact and accelerated break. Compact CORDON* breakers in BullDog Unit Substations combine the advantages of thermal magnetic breakers with current-limiting characteristics of Amp-traps**. . . offer greater protection at less cost.

**Trademark registered by I-T-E Circuit Breaker Company.*

***Trademark registered by Chase-Shawmut Company.*



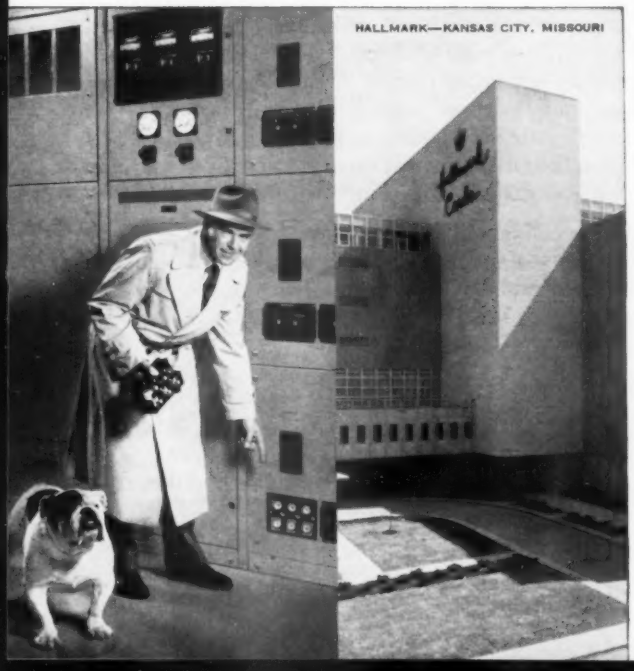
RCA—MOORESTOWN, NEW JERSEY



New circuits in seconds plus low-cost power

As power goes, so goes production. At RCA, BullDog BUStribution® Duct smooths kinks in *both* . . . assures absolute electrical flexibility. Lo-X® Duct distributes power with greatest efficiency, while Plug-In® Duct slims electrical costs of moving and adding machinery by as much as 47%. New circuits plug into power in seconds—without rewiring or electrical downtime.

The entire system can be easily expanded or completely relocated to meet changing power needs. Pioneered by BullDog, lightweight aluminum BUStribution Duct cuts handling and installation costs . . . trims maintenance to the bone.

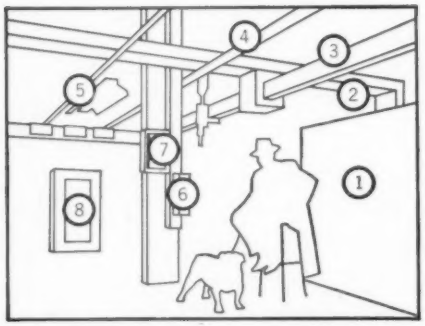


HALLMARK—KANSAS CITY, MISSOURI

Powered up to meet the future

←Hallmark is electrically fit. Its BullDog secondary distribution system will *keep* this new plant modern, too. BullDog Unit Substations, Power Panels and other switchgear not only serve *today's* needs best and most economically, but facilitate almost instant power expansion. Interchangeable switch units in BullDog Switchboards, for example, are available in a wide range of ratings. They can be quickly changed or new units can be easily added when electrical requirements change. Expandability like this keeps power ready, willing and *able—whatever* the future demands.

Electrical Fitness—*your key to more profits, new business*



PLANNED POWER—complete "Electrical Fitness"—is available to your customers in a system of coordinated BullDog components: 1. Unit Substation and Unit-Versal® Switchboards. 2. Lo-X® Feeder Duct. 3. Plug-in® Duct. 4. Industrial Trol-E-Duct®. 5. Universal Lighting Duct. 6. Pushmatic Electri-Centers®. 7. Clampmatic® Safety Switches. 8. Power Panels.

Look to BullDog for electrical equipment that consistently gives safe, dependable, versatile performance . . . offers you easy, effective ways to plan *electrically fit* power systems . . . earn new business and more profits. A BullDog field engineer will gladly be your "partner"—available at all times to help you study your customer's facilities, analyze his needs. He'll help you outline the best and most economical way to get your customers in top electrical shape and keep them there.

On a complete secondary distribution system or the smallest job—on unit substation or simple circuit breaker—look to BullDog products and to experienced BullDog engineering help. Check with your BullDog field engineer or write us direct.

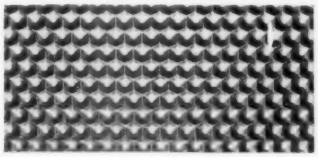
© BEPCO

BULLDOG

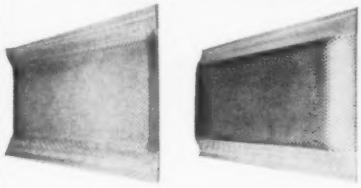
BullDog Electric Products Company, Division of I-T-E Circuit Breaker Company, Detroit 32, Mich. *BullDog Export Division:* 13 East 40th St., New York 16, N.Y. *In Canada:* BullDog Electric Products Co. (Canada) Ltd., 80 Clayson Rd., Toronto 15, Ont.

HEAT BETTER ELECTRICALLY

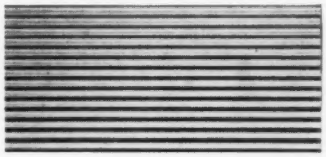
Your guide to engineered lighting glassware by Corning



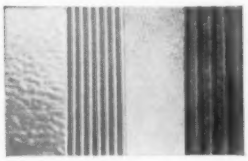
1. Pattern No. 70 Low-Brightness Panel. Lightweight, crystal glass with hexagonal prisms for high level of illumination with brightness reduced in the glare zones. Sizes to 34″ by 100″. Detailed in Bulletin L-110-A.



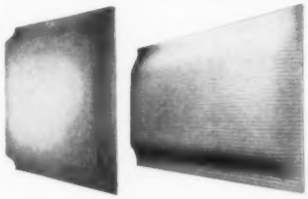
2. Low-Brightness Curved Lens Panels. Convex or concave, open and closed end. Sizes 10″ to 11″ wide, to 48″ long. Detailed in Bulletin L-110-B.



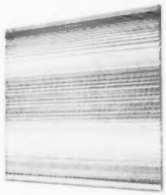
3. Pattern No. 83 Crysta-Lite crystal glass with linear prismatic pattern provides high efficiency and true color transmission. Sizes to 36″ by 100″. Detailed in Bulletin L-110-C.



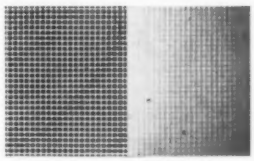
4. Alba-lite diffuses through glass composition rather than by surface treatment of glass. Light opal in smooth, ribbed, pebbled or fluted panels to 36″ x 100″. Detailed in Bulletin L-110-H.



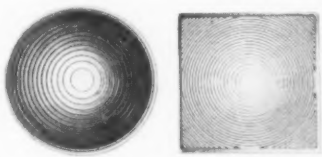
5. Troffer-curved Alba-lite Panel Convex, in ribbed or pebbled pattern, open or closed end. Sizes 10″ to 11″ wide and up to 48″ long—also nominally 24″ sq. Detailed in Bulletin L-110-D.



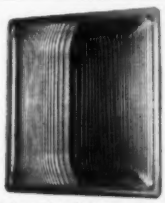
6. Twin-lite Lens Panel. Crystal glass with a prismatic, linear fresnel-type pattern. Effectively bends and controls fluorescent light. Size: 11″ wide, in lengths to 48″. Bulletin L-110-E.



7. Fota-lite has louvers right in the panel, produced by a unique photo-sensitive method. Combines advantages of single, slim panel with louvering. Panels with slanted or vertical white louvers up to 24″ x 48″. Detailed in L-110-F-G.



8. Lenslites for incandescent use. Made from heat-resistant glass and available in round, square, or rectangle shape, for standard fixtures of varying wattages. Bulletin LS-27 data sheets.



9. Corridor Lighting Lens. Dish-shaped and made from heat-resistant glass with a linear prismatic pattern that lights both corridor and lockers located along walls. 10⅞″ square. Bulletin LS-27, data sheet 10.



With lighting glassware by Corning you get the light control you need with the assurance of long-lasting performance and good looks. See how, where, and why to pick the *right* Corning lighting glassware by sending for a free copy of "Commercial Lighting Application Guide," Bulletin L-100. Ask also for any other literature mentioned for specific items.

CORNING GLASS WORKS, 65-5 Crystal St., Corning, N.Y.
Please send me "Commercial Lighting Application Guide" and

.....

Name.....

Company.....

Street.....

City.....Zone.....State.....

Corning means research in Glass

CORNING GLASS WORKS, 65-5 Crystal Street, Corning, N.Y

Ever see tougher operating conditions?

Tiger Brand Amerclad is made for this treatment



ON THE TRACK-TAMPING MACHINE shown here, the cable is flexed 4,500 times per minute. Eight powerful vibratory motors are used to drive eight tamping assemblies. Each motor is powered with Tiger Brand Amerclad cable.

It wasn't always that way. Other cable did a good job—for a while. But the shattering vibration actually caused the jackets to peel away from the conductors. Then Amerclad, with its dynamically balanced conductors and tough, lead-cured jackets, solved the problem. In fact, the manufacturer says, "Tiger Brand is superior to anything we have ever seen for this type of service. It is completely dependable under all conditions."

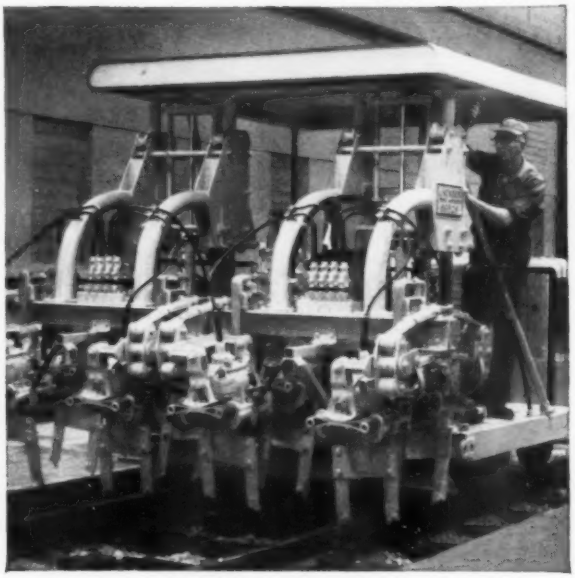
For an interesting contrast, look at the power shovel pictures, and the three-inch diameter Amerclad. It's the same kind of cable used on the track tamper, only bigger and with more conductors. Operating conditions are different, though. Some of the cable is right in the blast area where it is dragged over sharp rocks and pounded by dynamite-propelled boulders. The cable operates 24 hours a day at temperatures that range from 100° in the shade to minus 40° in shoulder-deep snow.

When you specify Tiger Brand Amerclad, this is the quality you get. We make no second- or third-grade line. *All* Amerclad is made to the same exacting specifications—designed for users who demand the very best because they can't afford expensive down time. Why not call your American Steel & Wire salesman and ask for more information about this quality cable?

USS, American, Tiger Brand and Amerclad are trademarks



Notice the long span of the cable bridge and the extreme flexibility of the Amerclad in the foreground. It's the same cable.



Railroad track tamper is a completely self-contained unit. Notice the eight cables which feed separate vibratory motors.



This is a typical power shovel at the mine. The Amerclad runs along the ties and under the tracks.



USS

Tiger Brand Electrical Wire & Cable

a standard Tiger Brand cable for every special job!

Asbestos Wire and Cable • Mold Cured Portable Cord • Shovel & Dredge Cable • Paper & Lead Cable • Varnished Cambric Cable
Interlocked Armor Cable • Special Purpose Wire & Cable • Aerial, Underground and Submarine Cable

American Steel & Wire
Division of USS **United States Steel**

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors • United States Steel Export Company, Distributors Abroad

CROUSE-HINDS ELECTRICAL

The World's Most


Explosion-Proof Delayed Action Arktite Plug Receptacle Equipment, Type CES

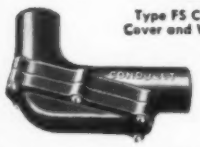


Arktite Receptacle with Spring Door, Type ARE

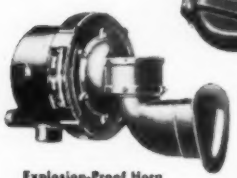


Type FS Conduit with Cover and Wiring Devices

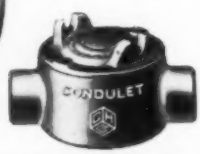

Explosion-Proof Circuit Breaker Conduit, Type FLB



Explosion-Proof Conduit for Pulling Cable, Type LBH


Explosion-Proof Horn Signal, Type ETH


Explosion-Proof Interlocked Plug Receptacle and Switch Conduit with Spring Door, Type FSQC



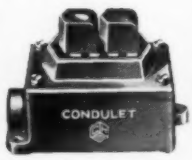
Explosion-Proof Junction Conduit, Type GUAC


Explosion-Proof Desk Type Telephone, Type ETDA


Explosion-Proof Junction Conduit with Union Hubs, Type GUAG


Dust-Tight Panelboard with Circuit Breakers, Type DVP

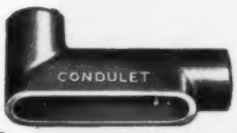

Explosion-Proof Combination Motor Starter and Circuit Breaker Conduit, Type EPC



Explosion-Proof Push Button Switch Conduit, Type EFS


Explosion-Proof Flexible Coupling, Type ECJ


Arktite Plug with Clamping Ring, Type APJ



Obround Conduit, Type LB


Explosion-Proof Time Delay Low Voltage Release Push Button Station Type OFC

CONDULET† Electrical Equipment

*Your guarantee of getting exactly what you want when you want it!

The Condulet line of Crouse-Hinds electrical equipment includes the widest selection of explosion-proof, dust-tight and conventional devices in the world. There is a broad choice of UL-approved equipment for every class and group under the National Electrical Code. Doubly tested – in factory and field – Crouse-Hinds equipment proves the unfailing worth of quality materials and manufacture. Thousands

A NATIONWIDE DISTRIBUTION exclusively through ELECTRICAL DISTRIBUTORS

†**CONDULET** is a coined word registered in the U.S. Patent Office. It designates a product made only by **Crouse-Hinds Company.**

CONDULETS

EQUIPMENT...



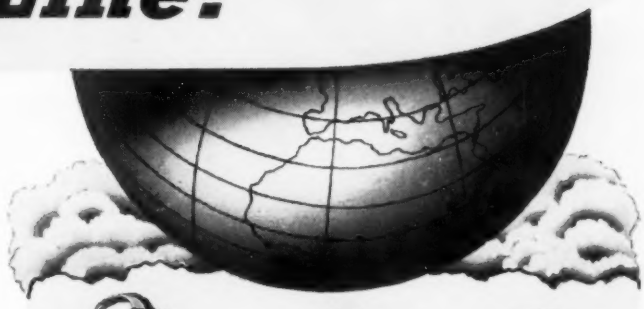
Complete* Line!

of Condulet installations are still in tip-top condition after twenty, thirty, or more than forty years of dependable service.

LIGHTING

Whatever range and intensity of lighting you require, there is a combination of Crouse-Hinds floodlights for every outdoor application, large or small. Crouse-Hinds lighting equipment is preferred in world-famous sports stadia . . . in hazardous areas in the chemical and petroleum industries . . . and for dozens of specialized uses such as tunnels, viaducts, display, signaling, and underwater lighting.

THERE ARE OVER 600 DISTRIBUTORS *throughout the country ready to serve and help you with your electrical installations. Crouse-Hinds product engineers will gladly make specific recommendations on any of your electrical problems.*





Explosion-Proof 150-W. Portable Floodlight, Type RCDR-6



Vaportight Lighting Fixture with Reflector, Type VDB



Explosion-Proof 500-W. Floodlight, Type RLEE-14



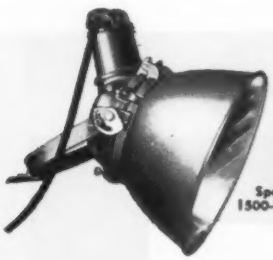
General Purpose Floodlights for 200-1000-Watt Lamps, Type MDB



Vaportight Industrial Lighting Fixture, Type VC



Explosion-Proof Lighting Fixture, Type EVA



Sports Floodlight for 1500-W. Lamps, Type FLA



Explosion-Proof Fixture For Fluorescent Lamps, Type EVF



Heavy Duty Industrial Floodlights for 200-2000-W. Lamps, Types ADE and LCE

Vaportight Portable Hand Lamp, Type VS





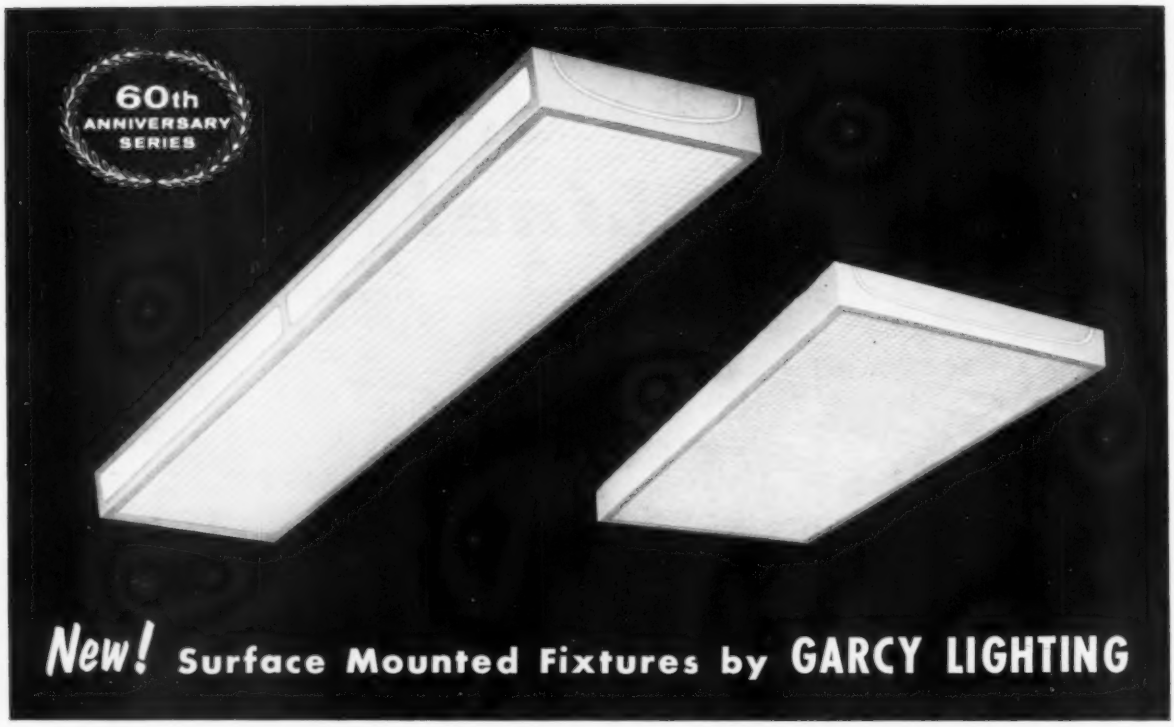
Explosion-Proof Fixture Hanger with Threaded Hub, Type EFHC

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FLOODLIGHTS TRAFFIC SIGNALS AIRPORT LIGHTING



New! Surface Mounted Fixtures by GARCY LIGHTING

- **2 or 4 lamp units, only 3½" deep**
- **Hinged one-piece enclosures**
- **Regular or translucent sides**
- **For 48" rapid start lamps**

Especially suitable for modern low ceilings, the 60th Anniversary Series embodies simplicity in design, glare-free visual comfort and efficient light utilization. This versatile series offers unique advantages to cost-conscious contractors.

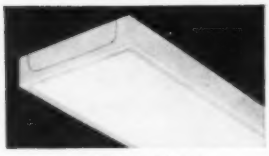
ONLY TWO BASIC PARTS TO INSTALL

1. Compact Chassis
2. One-Piece Enclosure

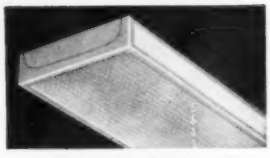


The lightweight chassis is easy to handle. Hinged enclosure is furnished ready for installation . . . no small parts to assemble.

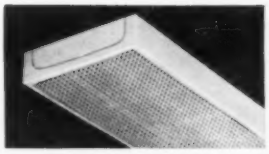
Your Choice of these Distinctive Treatments



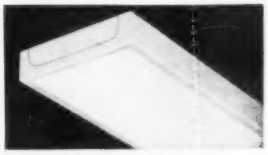
ALBA-LITE GLASS



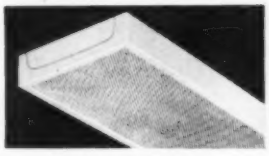
ONE-PIECE PLASTIC LOUVER



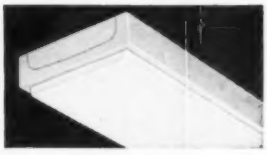
EXTRULITE CLEAR PLASTIC



FLAT PLEXIGLAS PANEL



LOW BRIGHTNESS LENS



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REGULAR SIDES

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Tear this page at the perforations—keep it handy for ready reference. Reverse side shows typical specifications for Remote Control Switches. For complete information, write for Publication 609 and Catalog 57-52.

how to specify AUTOMATIC TRANSFER SWITCHES

To assist specification engineers in their important task of drafting the specifications for automatic transfer switches designed into power and lighting distribution systems, ASCO presents herewith a classic specification format.

Left-hand column is devoted to those specifications particularly applicable to stand-by electric plant arrangements; the right-hand column shows those elements suitable for systems using either public utilities or electric plants as an emergency supply.

Common specifications (removed from their normal sequence) will be found beneath both columns.

WITH STAND-BY ELECTRIC PLANTS AS AN EMERGENCY SUPPLY...

...The stand-by plant shall be of the remote control type arranged to start and stop under the control of a pilot contact installed on the transfer switch.

An automatic transfer switch shall be provided with ..... poles for a normal source of ..... volts ..... phase ..... cycles, and an emergency source of ..... volts .... phase ..... cycles. The transfer switch shall be arranged to close a pilot contact for remote starting of the stand-by plant 3 seconds after normal source failure or after drop in voltage on any phase to (specify one) ( )70% ( )90% or less. The load circuits shall not be disconnected from the normal service during the 3 second delay period. When the stand-by generator is delivering not less than 90% of rated voltage and rated frequency, the load circuits shall be transferred.

Upon restoration of the normal source to not less than (specify one) ( ) 90% ( ) 95% of rated voltage on all phases, load shall be retransferred to the normal source after a time delay of 5 to 25 minutes (adjustable). After retransfer to the normal source, the engine shall run for 5 minutes unloaded and then automatically shut down and be ready to start upon the next failure of the normal source. If the stand-by plant should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of the normal source.

The transfer switch shall include the following accessories:

- Battery Charger ASCO Bulletin 203 for ..... volts.
- Test button to simulate normal source failure.
- Plant exerciser to exercise plant under load every 168 hours. Exercise period shall be 15 minutes plus selected retransfer time.
- Auxiliary contact fused and connected to stand-by plant source for remote indicating light.
- Auxiliary contact fused and connected to normal source for remote indicating light.

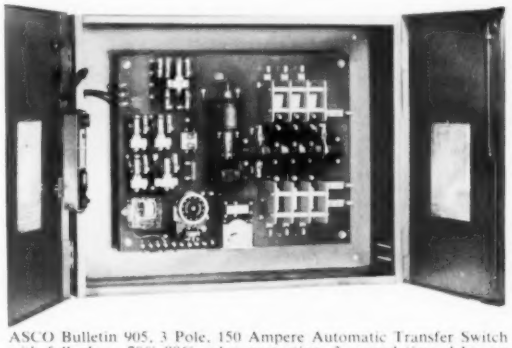
The transfer switch with the specified accessories shall be enclosed in a NEMA 1 cabinet suitable for wall mounting. A complete circuit diagram shall be attached to the inside of the cabinet door.

WITH ANY EMERGENCY SOURCE...

An automatic transfer switch shall be provided ..... poles for a normal source of ..... volts ..... phase ..... cycles and an emergency source of ..... volts ..... phase ..... cycles to transfer the load circuits to the emergency source when any phase of the normal drops below 70%, and to automatically retransfer the load circuits to the normal source when all phases are 90% or more. An auxiliary contact shall close an indicating circuit when the load circuits are connected to the emergency source.

The transfer switch shall have adequate capacity for total load of ..... amperes, consisting of approximately .....% tungsten lamp load and .....% motor and other loads.

Numerous accessory devices such as time delay against momentary outage, time delay on retransfer to normal, and others are considered indispensable in many applications. A list of accessories is included in all Bulletins; when using this specification please refer to ASCO Catalog 57-51 for the necessary accessories.



ASCO Bulletin 905, 3 Pole, 150 Ampere Automatic Transfer Switch with full phase 70%-90% relay protection, 3 second time delay on momentary outage, adjustable time delay on retransfer to normal, 5 minute no-load running time for plant after retransfer, plant exerciser, and battery charger. Panel also includes charging disconnect relay to prevent overcharging of battery.

COMMON SPECIFICATIONS

The transfer switch shall be a double throw switch operated by a single coil mechanism momentarily energized. The switch shall be inherently interlocked mechanically and electrically. Operating current for transfer shall be obtained from the source to which the load is to be transferred. Failure of any coil or disarrangement of any part shall not permit a neutral position. The switch shall be positively locked mechanically on either source without use of hooks, latches, semi-permanent magnets or springs. Main contacts shall be silver surfaced, and protected by arcing contacts.

Switches rated for noninductive loads shall include arc barriers between poles, and shall be ASCO:

( ) Bulletin 905 type for (specify required rating) ( )30 ( )60 ( )150 ( )200 amperes.
( ) Bulletin 908 type for 100 amperes.
( ) Bulletin 907 type for (specify required rating) ( )300 ( )400 amperes.

Switches rated for inductive loads shall be equipped with magnetic blowouts and arc barriers on all poles, and shall be ASCO:

( ) Bulletin 906 type for (specify required rating) ( )100 ( )150 ( )200 ( )300 ( )400 ( )600 ( )800 ( )1000 amperes.

The Automatic Switch Company offers its services in the preparation of suitable specifications for any application.

Automatic Switch Co. 50-J Hanover Road, Florham Park, New Jersey • FRontier 7-4600

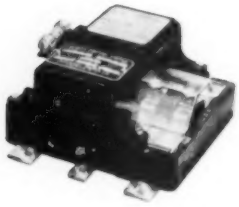
ASCO.

Tear this page at the perforations—keep it handy for ready reference. Reverse side shows typical specifications for Automatic Transfer Switches. For complete information, write for Publication 609 and Catalog 57-S1.

how to specify REMOTE CONTROL SWITCHES

For lighting and mixed loads to 600 volts A-C, 250 volts D-C, 30-200 amperes . . .

Specify ASCO Bulletin 920 Remote Control Switches



Characteristics:

- RATED IN AMPERES PER POLE FOR NONINDUCTIVE LOAD TO 600 VOLTS A-C AND 250 VOLTS D-C MAXIMUM.
- SIZES 30 TO 200 AMPERES, 2 AND 3 POLE SINGLE THROW.
- SUITABLE FOR TUNGSTEN LAMP LOAD, FLUORESCENT AND ALL OTHER TYPES OF LIGHTING LOADS.
- NO DERATING WHEN USED ON HIGH INRUSH LOADS SUCH AS TUNGSTEN LAMP LOAD.
- INTERRUPTING CAPACITY 150% OF RATED CURRENT.
- LISTED BY UNDERWRITERS LABORATORIES FOR TUNGSTEN LAMP LOAD TO FULL RATING.

For Lighting and Mixed Loads to 250 Volts A-C, 30-400 Amperes, specify ASCO Bulletin 910

SUGGESTED SPECIFICATIONS

1. The Remote Control Switches shall be of the single coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches or semi-permanent magnets. Control stations shall be required to make but not break the operating coil current.
2. Main contacts shall be double break silver to silver type protected by arcing contacts. Contacts shall be self-aligning and renewable from the front of the panel.
3. Control connections shall be clearly marked "L" for line wire, "C" for closing wire, and "O" for opening wire. A manual operating lever shall be included.
4. Switches shall be Underwriters' Laboratories listed at full load rating for use with gas-filled tungsten filament lamps, and shall be the approved equal of the Automatic Switch Company "Type RC" Bulletin 920 Remote Control Switch.

For small panelboards . . .

Specify ASCO Bulletin 909 Remote Control Switches



Characteristics:

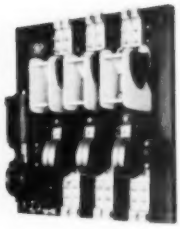
- RATED 30 AMPERES PER POLE FOR NON-INDUCTIVE LOAD TO 250 VOLTS A-C AND 125 VOLTS D-C.
- SUITABLE FOR TUNGSTEN LAMP LOAD, FLUORESCENT AND ALL OTHER TYPES OF LIGHTING LOADS.
- INTERRUPTING CAPACITY 150% OF RATED CURRENT.
- DOUBLE BREAK CONTACTS.

SUGGESTED SPECIFICATIONS

1. The Remote Control Switches shall be of the single coil, electrically operated mechanically held type. Positive locking shall be obtained without the use of hooks, latches or semi-permanent magnets. Control stations shall be required to make but not break the operating coil current.
2. Main contacts shall be double break silver alloy and shall be self-aligning and renewable from the front of the panel.
3. Switches shall be the approved equal of Automatic Switch Company, Bulletin 909, 250 volts, 30 amperes full rating for non-inductive load and for gas-filled tungsten filament lamp load.

For high capacity, highly inductive loads . . .

Specify ASCO Bulletin 911 Remote Control Switches



Characteristics:

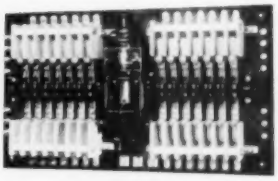
- RATED IN AMPERES PER POLE FOR ALL CLASSES OF LOAD A-C OR D-C.
- STANDARD LISTING IN CAPACITIES FROM 30 TO 1000 AMPERES TO 600 VOLTS A-C AND 250 VOLTS D-C.
- AVAILABLE TO 750 VOLTS A-C OR D-C.
- CURRENT COIL TYPE MAGNETIC BLOWOUT ON EACH POLE.
- INTERRUPTING CAPACITY TO 15 TIMES RATED CURRENT.
- THERMAL CAPACITY NOT LESS THAN 20 TIMES RATED CURRENT.
- NO DERATING REGARDLESS OF CLASS OF LOAD.

SUGGESTED SPECIFICATIONS

1. The Remote Control Switches shall be of the single coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches or semi-permanent magnets. Control stations shall be required to make but not break the operating coil current.
2. Main contacts shall be silver surfaced and shall be protected by arcing contacts and magnetic blowouts with arc barriers. Contacts shall be renewable from the front of the panel.
3. Control terminals shall be clearly marked "L" for line wire, "C" for closing wire, and "O" for opening wire. A manual operating lever shall be included.
4. Switches shall be suitable for all classes of load to full rating and shall be the approved equal of ASCO Bulletin 911 Remote Control Switches.

For multi-pole requirements . . .

Specify ASCO Bulletin 915 Remote Control Switches



Characteristics:

- UP TO 24 POLES DOUBLE THROW.
- RATED IN AMPERES PER POLE FOR NONINDUCTIVE LOAD TO 250 VOLTS A-C.
- STANDARD LISTING IN CAPACITY OF 30 AMPERES. AVAILABLE TO 100 AMPS.
- SUITABLE FOR TUNGSTEN LAMP LOAD, FLUORESCENT AND ALL OTHER TYPES OF LIGHTING LOADS.
- INTERRUPTING CAPACITY 150% OF RATED CURRENT.
- BARRIERS BETWEEN POLES.

SUGGESTED SPECIFICATIONS

1. The Remote Control Switches shall be of the single coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches or semi-permanent magnets. Control stations shall be required to make but not break the operating coil current.
2. Main contacts shall be silver alloy with adequate opposite polarity spacing between poles. All poles shall be protected by arc barriers. Contacts shall be self-aligning and renewable from the front of the panel.
3. Control terminals shall be clearly marked "L" for line wire, "C" for closing wire, and "O" for opening wire. A manual operating lever shall be included.
4. Switches shall be suitable for use up to full rating on gas filled tungsten lamp load and other noninductive loads, and shall be the approved equal of ASCO Bulletin 915 Remote Control Switches.

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this "library of lighting" for specification writers

Form No. 1650
IL Commercial Catalog

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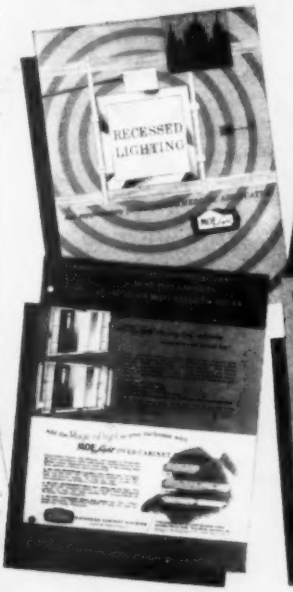
Form No. M-163
Residential Lighting

MOE LIGHT's "Heavenly Touch of Light" in dozens of beautiful, full color room-settings; every type of room and budget. More than 400 fixtures shown.



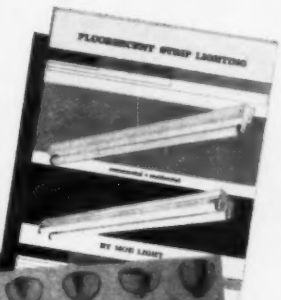
Form No. 1605R
Recessed Lighting Manual

Many types, sizes, styles, trims; answers frequently asked questions. Full color pictures of many installations. Wiring diagrams; coefficient tables; specifications.



Form No. 1664
Strip Lighting

Fluorescent strip units; installing valance, cornice, cove lighting; power factors, dimmer ballasts, etc. Complete MOE LIGHT strip lighting fixture line.



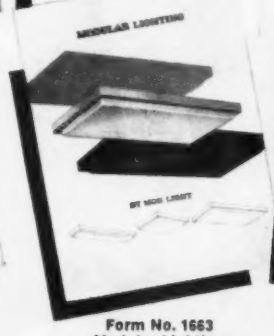
Form No. 1665
Drum Lighting

Concise, detailed exposition of most-used utility fixtures, wide variety of sizes, types, styles. Candlepower tables; graphs.



Form No. 1663
Modular Lighting

Efficient fluorescent ceiling squares for large office areas, general commercial use. Popular sizes, lamp capacities, types.

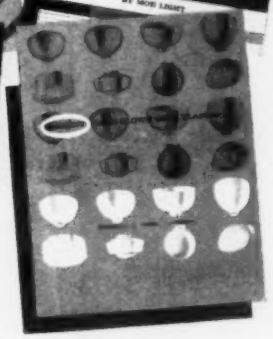


Form No. MC-1017A
Bathroom Cabinets

Catalog sheet showing high-style cabinets in swinging door and sliding door styles; top lighted, side lighted, unlighted.

Form No. 200
Radiant Opal Glassware

Catalog sheet of high efficiency blown-type glass for schools, offices, stores, hotels, etc. Sizes to fit all street light standards.



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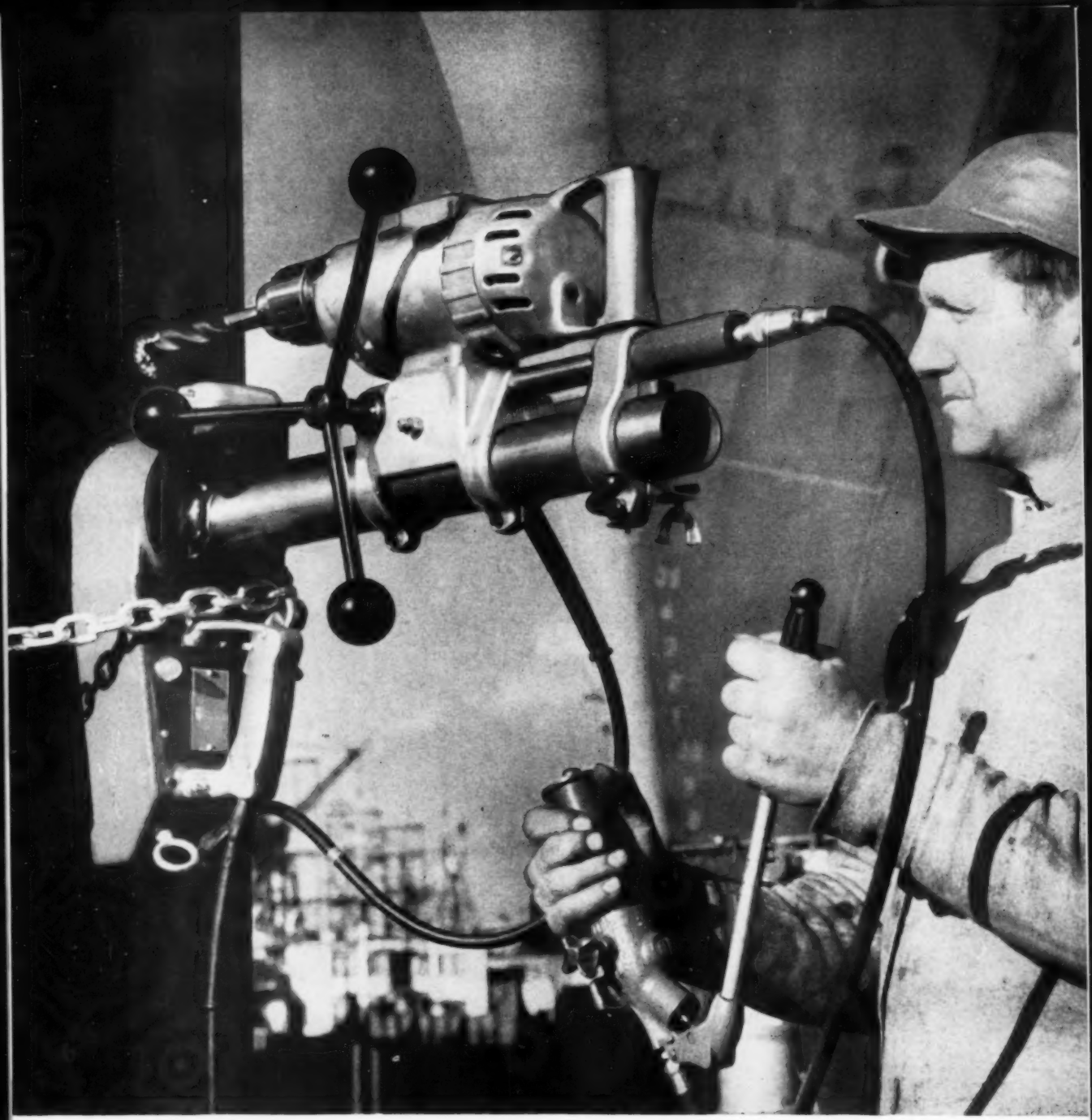
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Sticks like glue . . . works in

You are looking at a Black & Decker Magnetic Drill Press at work 15 feet off the ground! No operator holds it—it *holds itself* to the work with over a thousand pounds of magnetic power. No operator touches it—he feeds it precisely into the work with fingertip pressure on the exclusive B&D Hydra-Power Feed.

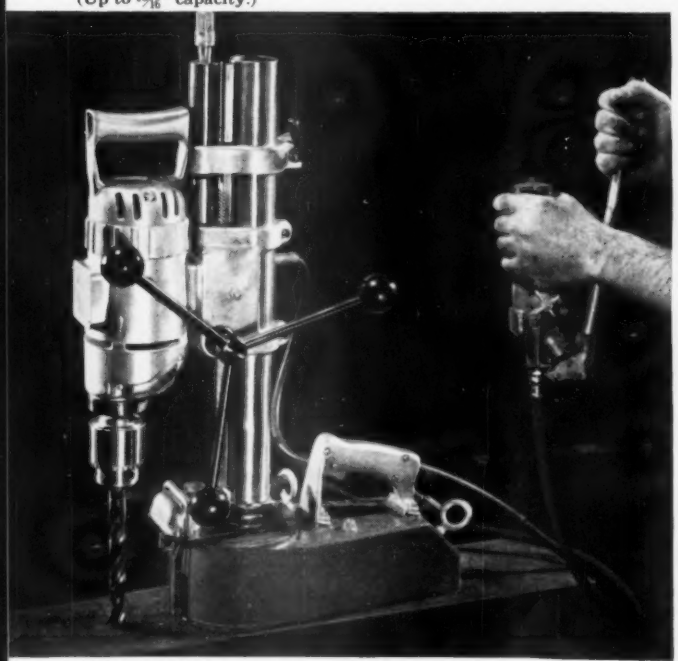
The new B&D Magnetic Drill Presses are truly so unusual they must be seen to be appreciated. They come in two capacities—¾″ and 1¼″. They are complete precision units—not attachments. They drill, ream and tap upside down, on their sides or upright. They are ideal for tool shops, steel fabricators, heavy machinery, maintenance . . . anywhere you have to take a drill press to the work. THE BLACK & DECKER MFG. Co., Dept. 1205, Towson 4, Maryland. (In Canada: Brockville, Ontario.)

See the Features of the NEW Black & Decker Magnetic Drill Presses



1¼" MAGNETIC DRILL PRESS works high in the air upside down! (Up to 1¼" capacity.)

¾" MAGNETIC DRILL PRESS goes to the work, drills upside down, too! (Up to 13/16" capacity.)



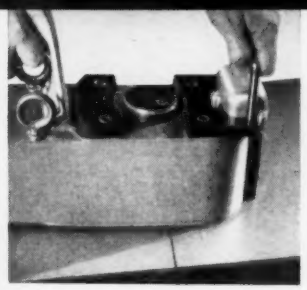
any position!

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Look Under "TOOLS-ELECTRIC" in 'Yellow Pages'

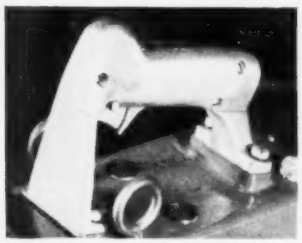


★ MULTIPLE USE! Magnetic Unit of 1¼" Press may be used to hold pieces for butt welding, etc!

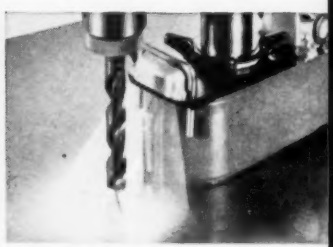


★ CLOSEST TOLERANCES! Drill Point Locator provides accuracy never before possible! Built into magnet.

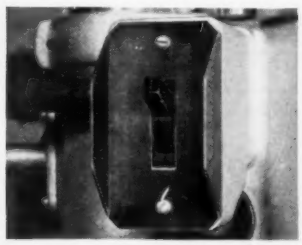
Check these exclusive Black & Decker features!



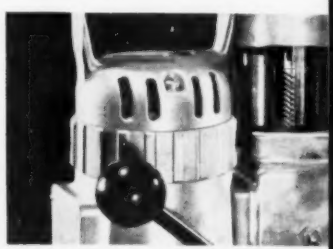
★ SAFETY-GRIP SWITCH keeps magnet always "on" after operator releases switch trigger—another safety plus.



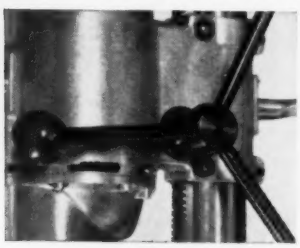
★ WORK AREA BRIGHTLY LIT by exclusive headlight. Special ruggedized bulb withstands hard usage.



★ LONGER LIFE—INCREASED SAFETY results from built-in time delay in 1¼" Reversing Switch. Prevents motor being reversed too rapidly.



★ LONGER LIFE—INCREASED SAFETY as Reversing Switch of ¾" Press is turned. Switch goes to "neutral" then "on" again in other direction.



★ HIGHEST ACCURACY results from unitized construction of drill press—cannot work loose, no side play . . . Drill Press is an integral unit.



★ DRASTICALLY INCREASED SAFETY due to location of magnet near drill point. Provides maximum magnetic power at drill pressure point.

MAIL COUPON TODAY FOR A FREE DEMONSTRATION!

THE BLACK & DECKER MFG. CO., Dept. 1205, Towson 4, Md.

☐ Please arrange a demonstration of your ☐ 1¼"; ☐ ¾" Magnetic Drill Press

☐ Please send me additional information

Name_____Title_____

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an unbeatable combination!

1100 years of practical experience . . .

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MARYLAND

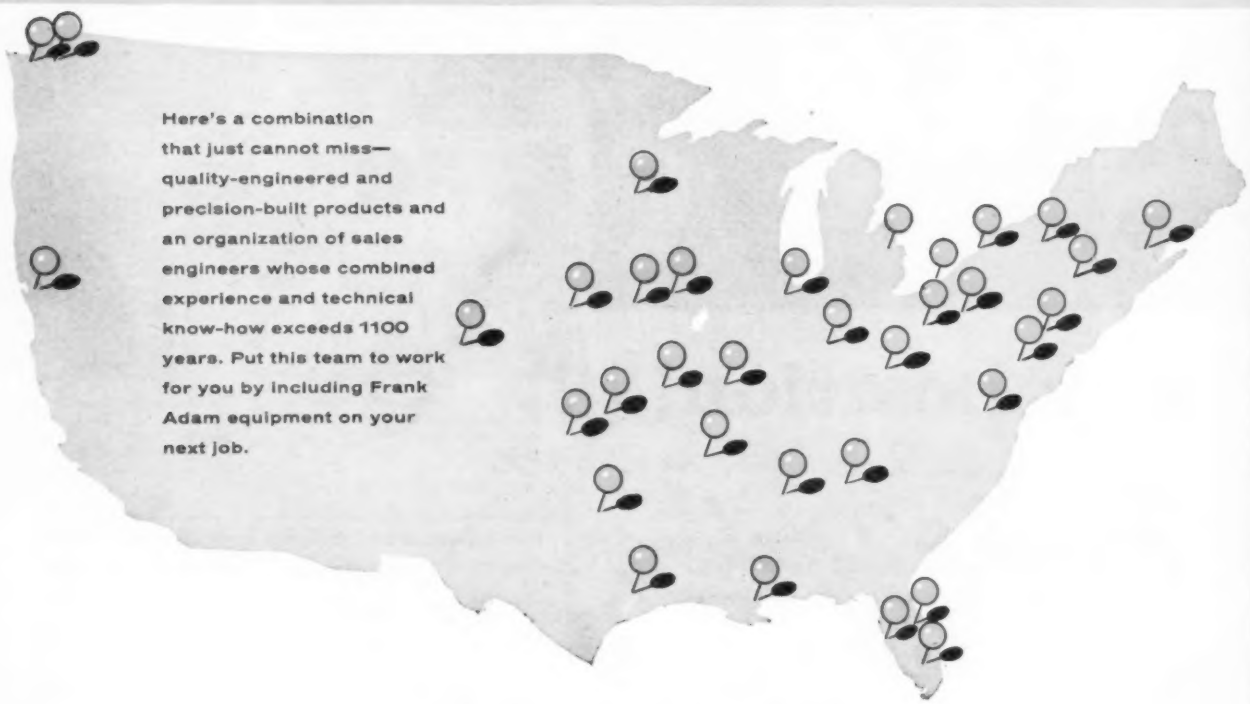
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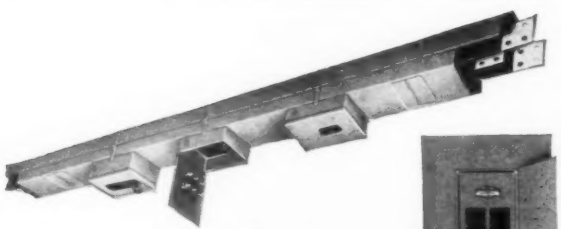
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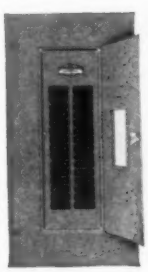
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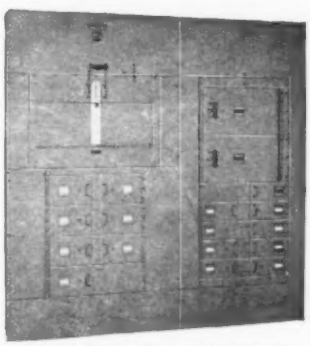
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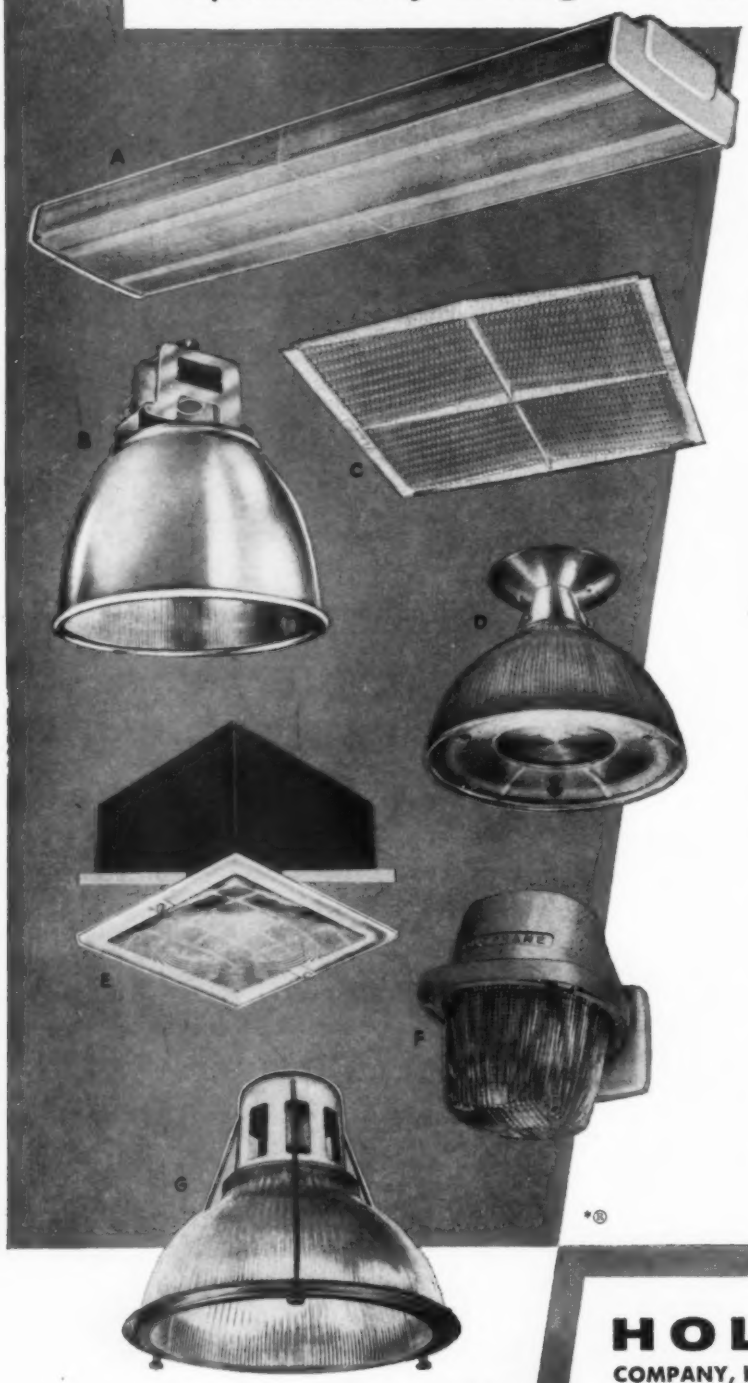
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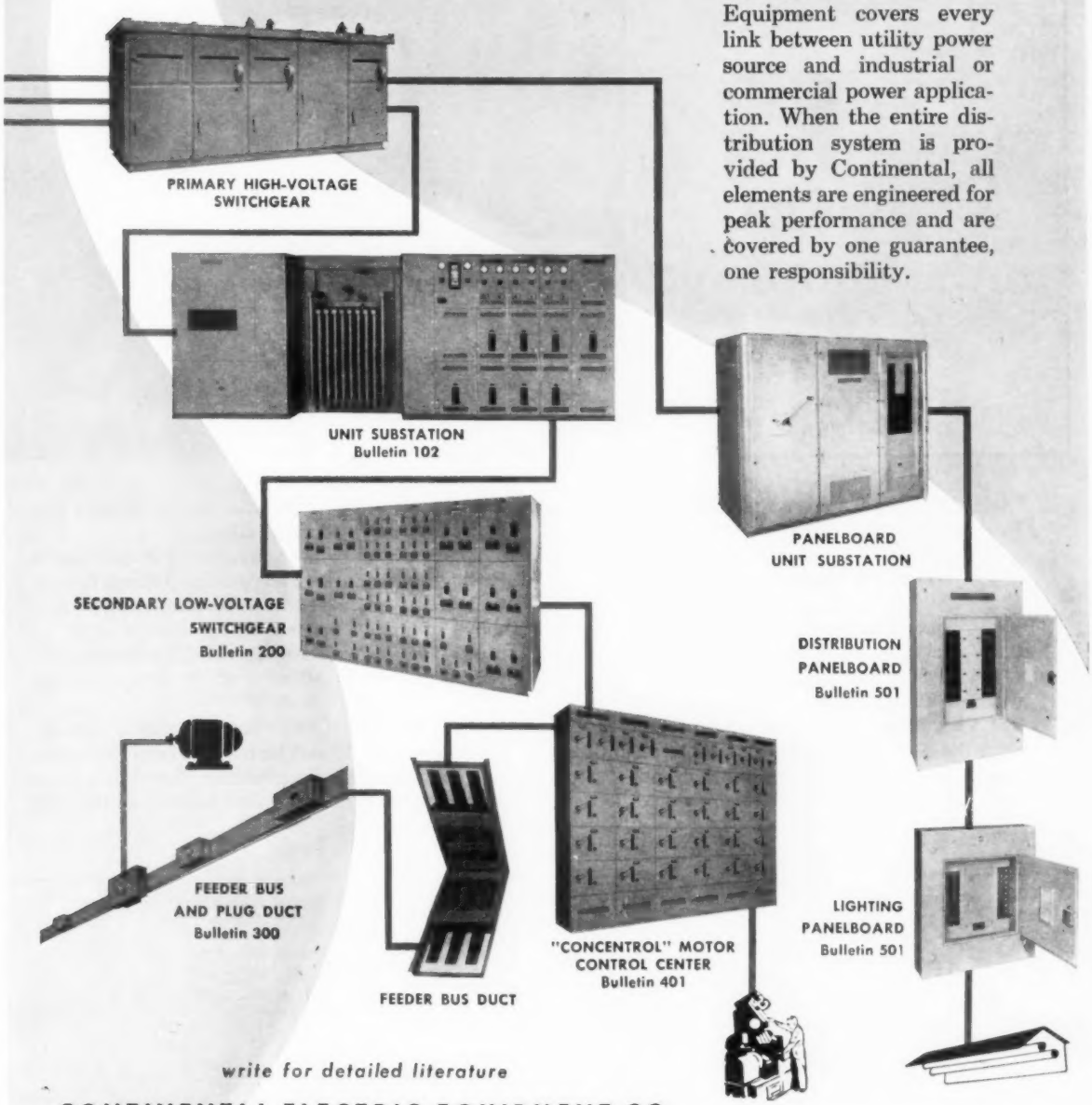
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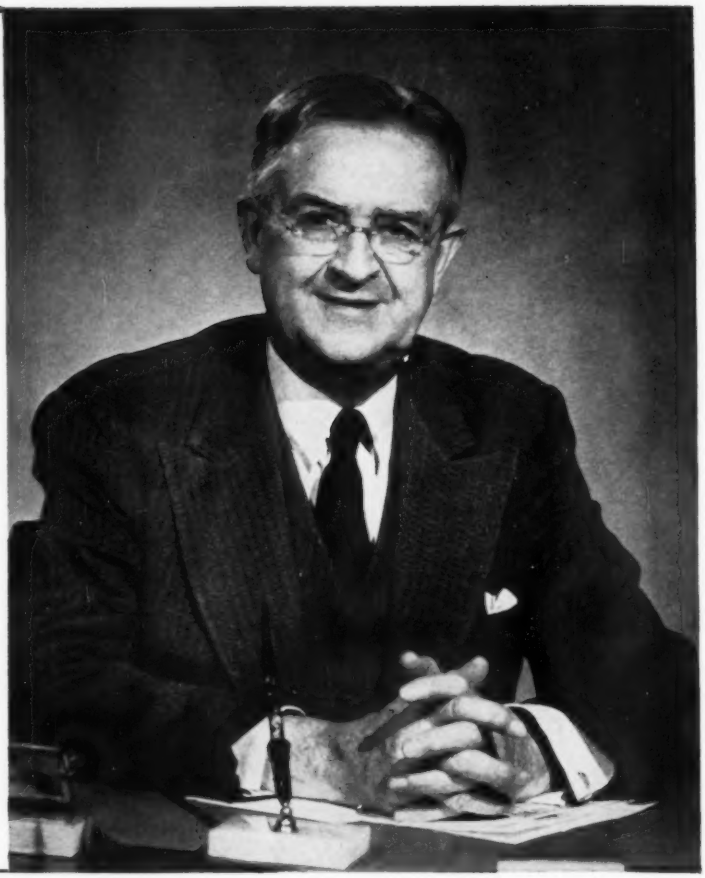
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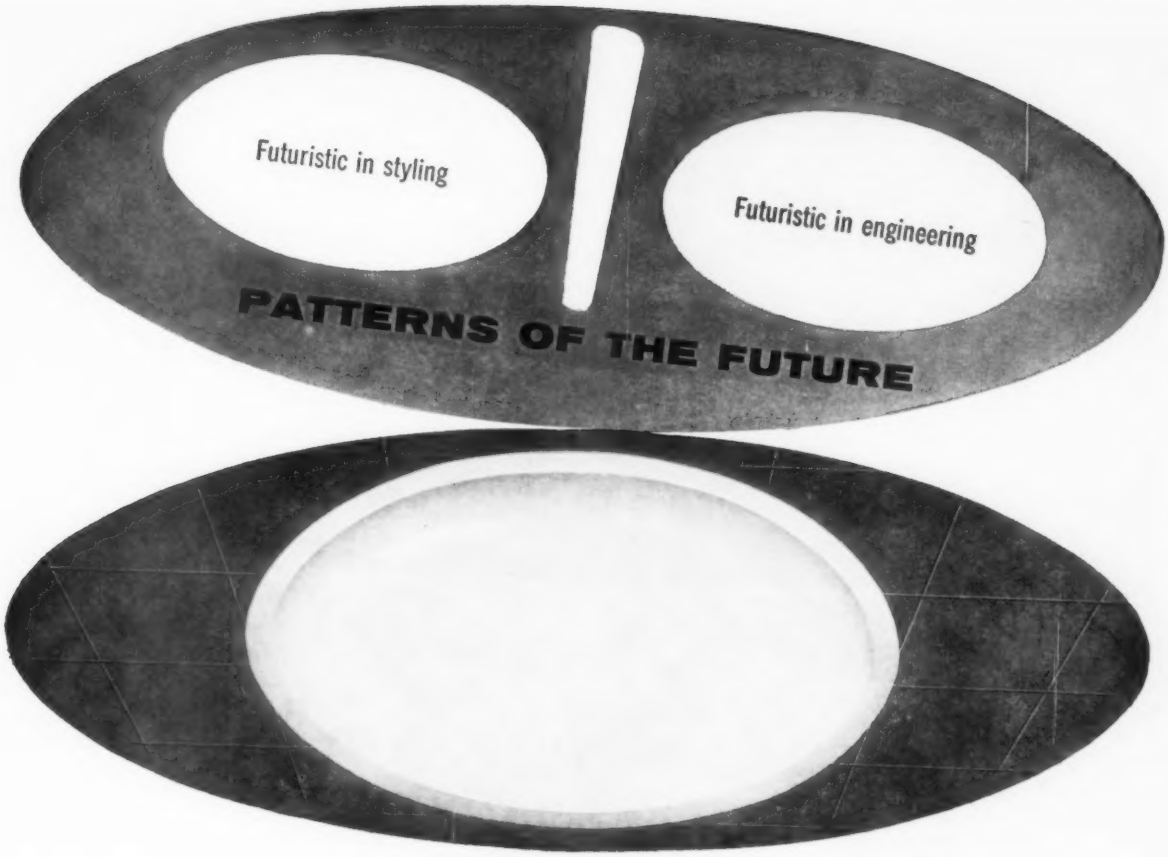
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48-250 open reflector downlight uses inexpensive general service type lamps up to 300 watts. Most often specified for department stores, banks and public lobbies.





Chemical Corn Exchange Bank, New York

48-500 high ceiling ellipsoidal open reflector downlight for auditoriums, churches, museums. Available with Alzak natural or golden reflector in 300, 500, 750 and 1,000 watt sizes.



48-1220 for gymnasiums and lunchrooms, playrooms and arenas. Spoke guard is of solid cast aluminum, heat-treated for strength. Available for surface, recessed, pendant or I-beam installations. Wattages up to 1,000 . . . also in mercury vapor series.



This photographic report taken by the Committee on Lighting of the Central Station Properties, Illuminating Engineering Society in October 1954 visually proves the importance of properly ventilated lamp husks.

Dirty	Improvement	Cleanest
No. 1 Test	No. 2 Test	No. 3 Test
No vents	Vents poorly located	Vents properly located

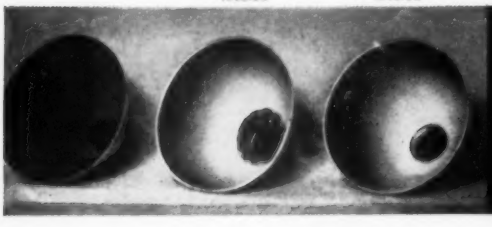
downlights by mc Philben

cooler burning
lower maintenance costs
tested and proved

mcPhilben's 48 series interior downlights were selected to light the main area of the Chemical Corn Exchange Bank in New York in 1957. Today, after more than a year of operation, maintenance engineers report an operating efficiency and lamplife unequalled by any other downlight in use.

All mcPhilben interior downlight units are equipped with cast aluminum radiators and cooling fins. This outstanding engineering feature assures cooler burning and longer lamplife. In addition, reflectors remain cleaner and brighter for longer . . . as proved in the I.E.S. test shown below.

Full details on these downlights are now available on individual specification data sheets. Ask your mcPhilben representative for your copies or write to mcPhilben. Ask for the 48 and 84 lines.

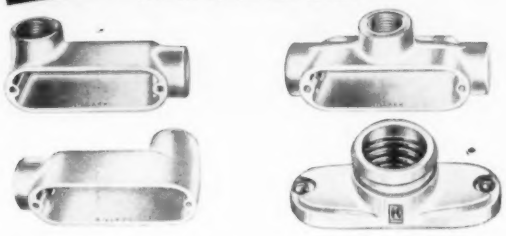


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SPECIFY Killark THE ALL-ALUMINUM LINE

- **Non-rusting, non-corroding**—weather and industry proof, clear through!
- **60% Lighter than Iron**—easier to handle.
- **Smooth Inside and Out**—prevent wire and hand skinning.
- **Clean-Cut Threads**—precise fit, easier installation.
- **Non-Sparking**—never any danger of fire or explosion.

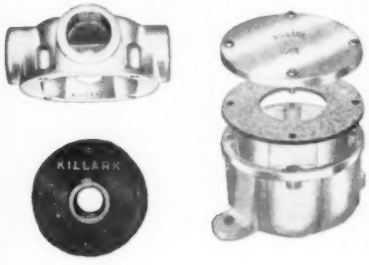
CONDUIT BODIES AND COVERS



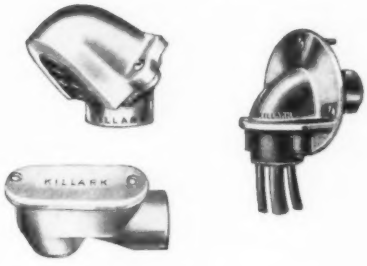
EXPLOSION-PROOF FITTINGS AND SWITCHES



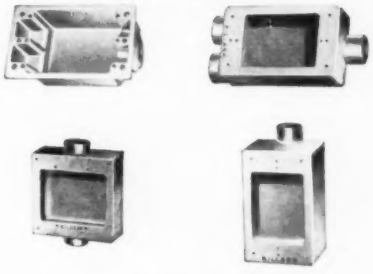
ROUND FITTINGS AND COVERS



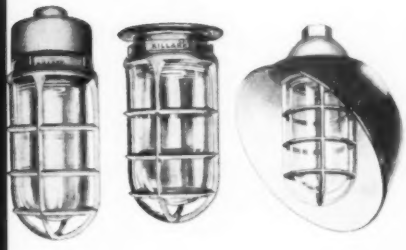
SERVICE ENTRANCE FITTINGS



FLUSH SWITCH FITTINGS



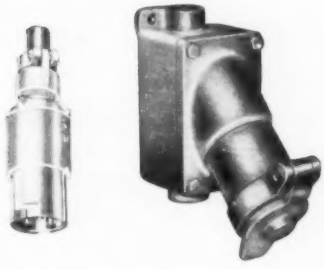
VAPOR-TIGHT LIGHT FIXTURES



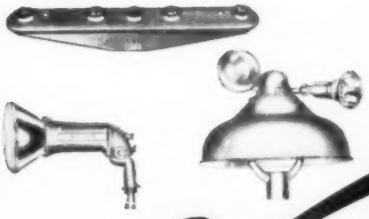
EXPLOSION-PROOF LIGHT FIXTURES



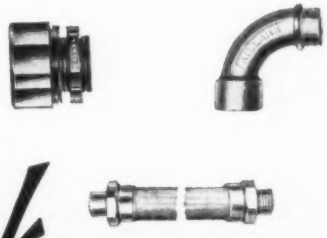
EXPLOSION PROOF PLUGS AND RECEPTACLES



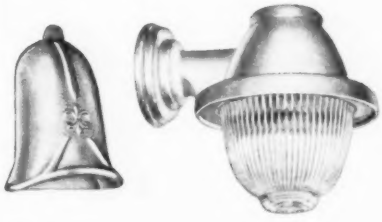
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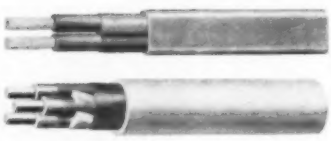
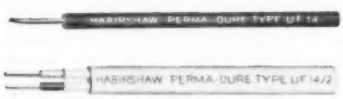
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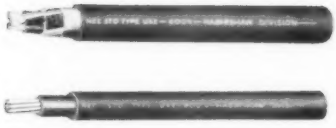
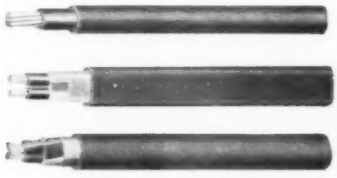
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Baltimore 18, Leo T. McCourt Co., 11 West 25th St.
Boston 27, Electrical Agencies, Inc., 49-51 "D" St.
Buffalo, Eberhardt Electric Sales, 278 Johnson St.
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Phoenix, Kenneth Anderson Co., c/o Mr. Melvin C. Long, 422 S. 7th Ave.
Pittsburgh 9, Crescent Sales Co., Inc., 4830 McKnight Road
San Francisco, F. M. Nicholas Co., 714 Harrison St.
Seattle 4, Northwestern Agencies, Inc., 4130 First Ave., S.

Index of Phelps Dodge

Wires and Cables	Type Letter	Habirshaw Trade Name or Designation	Maximum Operating Temperature	USE
	R	Flamestop Code	60 C (140 F)	Dry Locations
	RF	Flamestop Code	60 C (140 F)	Fixture Wire
	RH	Flamestop Heat-Resistant	75 C (167 F)	Dry Locations
	RW	Flamestop Moisture-Resistant	60 C (140 F)	Dry and Wet Locations
	RH-RW	Flamestop Heat or Moisture-Resistant RH-RW	75 C (167 F) as RH	Dry Locations as RH
			60 C (140 F) as RW	Dry and Wet Locations as RW
	RHW	Flamestop Heat and Moisture Resistant	75 C (167 F)	Dry and Wet Locations
	RHH	Flamestop Heat-Resistant	90 C (194 F)	Dry Locations
	RL	Rubber Lead	60 C (140 F)	Wet Locations and other Special Conditions
	RHL	Heat Resistant Rubber Lead	75 C (167 F)	Wet Locations and other Special Conditions
	NM	PD-X Nonmetallic-Sheathed Cable	60 C (140 F)	For Wiring Houses, Rural Buildings, Small Stores, and Shops.
	UF UF-NMC	Perma-Dure Nonmetallic-Sheathed Cable	60 C (140 F)	UF: Underground Feeder and Branch Circuit Cable for Direct Burial. NMC: For Interior Wiring in Moist or Corrosive Locations.
	TW	Habirdure Thermoplastic Insulated	60 C (140 F)	Dry and Wet Locations
	TF		60 C (140 F)	Fixture Wire
	TW	Petro-Dure Thermoplastic Insulated Nylon Jacketed	60 C (140 F)	Moist locations and where exposed to mineral oil, liquid gasoline and gasoline vapor.
	None	Habirdure Machine Tool, Control, and Switchboard Wire	90 C (194 F) in air 80 C (176 F) in oil	Machine Tool, Control and Switchboard Wiring

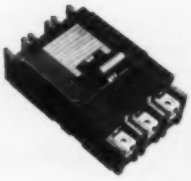
PHELPS DODGE COPPER PRODUCTS CORPORATION

Wires and Cables

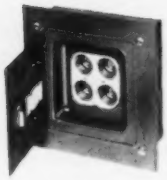
Wires and Cables	Type Letter	Habirshaw Trade Name or Designation	Maximum Operating Temperature	USE
	None	Habirdure Appliance Wire	105 C (221 F) IN AIR 80 C (176 F) IN OIL	Appliance Wiring
	SE	Service Entrance Type SE—Style U Unarmored	75 C (167 F)	Service Entrance or Combination Service Drop & Service Entrance
	SE	Service Entrance Type SE—Style A Armored	75 C (167 F)	Service Entrance or Combination Service Drop & Service Entrance
	SD	Service Drop Type SD	60 C (140 F)	Service Drop
	USE	Service Entrance Type USE	60 C (140 F)	Underground Service Entrance, Direct Burial.
	V	Varnished Cambric Braided	85 C (185 F)	Dry locations only. Smaller than No. 6 by special permission.
	VL	Varnished Cambric Lead	85 C (185 F)	Wet or Dry locations. Smaller than No. 6 by special permission.
	None	Type RR	75 C (167 F) Low Voltage 85 C (185 F) High Voltage	General Purpose for Direct Burial, Aerial, Conduit and Underground Duct Installations.
	S or SO	Hard Service Cord	60 C (140 F)	Pendant or portable extra hard usage in damp locations; SO for oil resistance.
	SJ or SJO	Junior Hard Service Cord	60 C (140 F)	Pendant or portable hard usage in damp locations; SJO for oil resistance.
	SP (Formerly POSJ)	All Rubber Parallel Cord	60 C (140 F)	For use in pendant or portable applications in damp locations not subject to hard usage

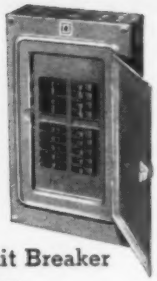
HABIRSHAW BUILDING WIRES AND CABLES





• Safety Switches and Industrial Circuit Breakers



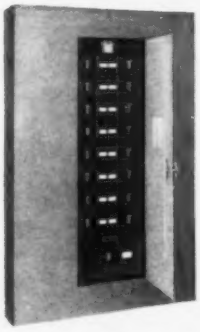


• Fusible and Circuit Breaker Load Centers



• Voltage Testers





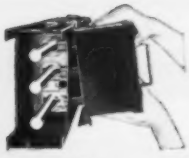
• Fusible and Circuit Breaker Lighting and Power Panelboards

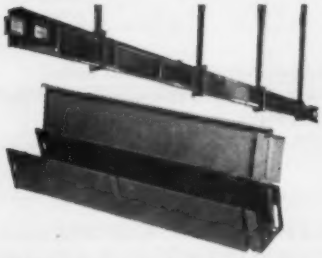




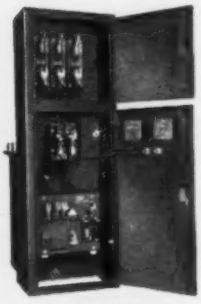
• Power Distribution Switchboards and Switchgear

Wherever Electricity

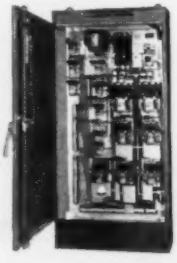




• Busways and Wireways



EC&M High Voltage and Synchronous Starters



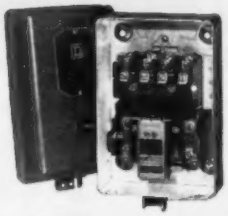
• Special Purpose Control



• Control Centers

SQUARE D COMPANY

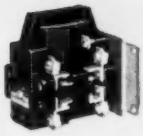




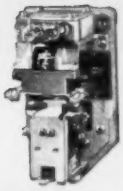
• A.C. Manual and Magnetic Starters



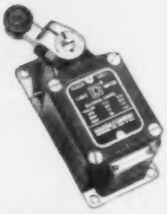
• Drum Switches



• Control Relays



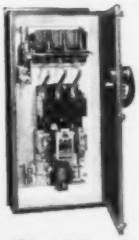
• Timing Relays



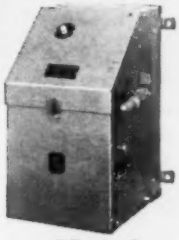
• Limit Switches



• Pushbuttons



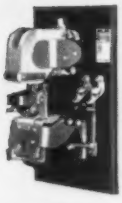
• Combination Starters



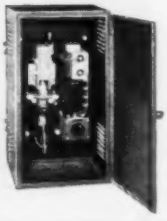
• Manual Compensators



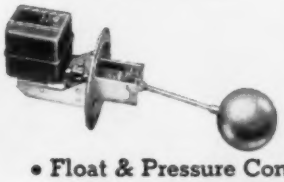
• All Types of Reduced Voltage Starters

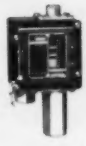


• D.C. Starters



• Electronic and Electro-Magnetic Welder Control



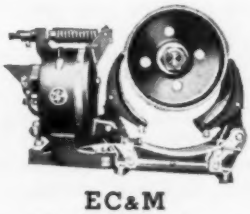


• Float & Pressure Controls for Pumps & Compressors

is Distributed and Controlled

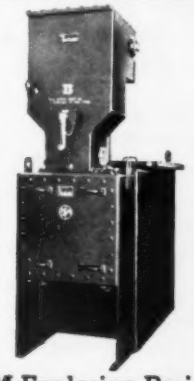


EC&M Lifting Magnets

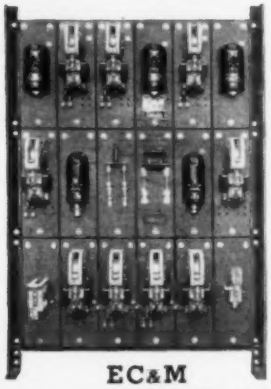


EC&M Magnetic Brakes

FIELD ENGINEERING SERVICE
available through Square D branch offices in all principal United States cities
... and in Canada, Mexico and England



EC&M Explosion-Resisting Control for Petroleum Industry



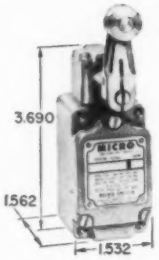
EC&M Crane and Mill Control

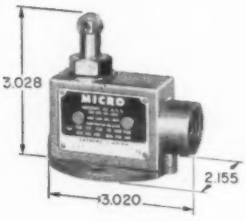
DESIGN LEADERSHIP FOR MORE THAN 50 YEARS

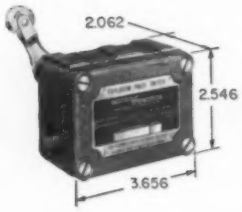
MICRO SWITCH Precision Switches

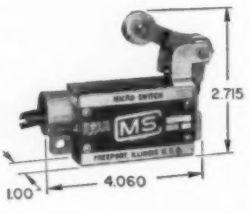


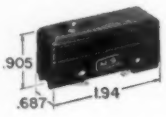


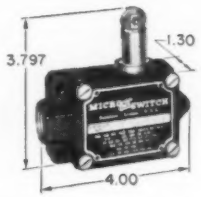












Automate existing production equipment with

MICRO SWITCH Precision Switches

Electrical contractors are finding the design and installation of simple and practical automation projects profitable for themselves and their customers.

You can build *automation*—machine by machine and plant by plant—for your customers with MICRO SWITCH precision switches . . . and everybody wins when you do.

Hundreds of plants are already using 500 or more MICRO SWITCH precision switches . . . most of them bought from and installed by local contractors. One contractor is now automating a third plant for a customer. In another plant, the savings are running $4,000 a month from this kind of *automation*.

This kind of *automation* is relatively simple, and is wanted by more and more plants of every size. The assistance of the MICRO SWITCH staff of Field Sales Engineers and of the hundreds of Authorized Distributors is available to you.

Why not start today helping your customers to automate the simple MICRO SWITCH way? Send for catalogs No. 83 and No. 101, and Bulletin 20 on "Plug-In Limit" switches.

MICRO SWITCH . . . Freeport, Illinois
A Division of Honeywell.

The two-word name MICRO SWITCH is NOT a generic term. It is the name of a division of Honeywell.

Honeywell
MICRO SWITCH PRECISION SWITCHES

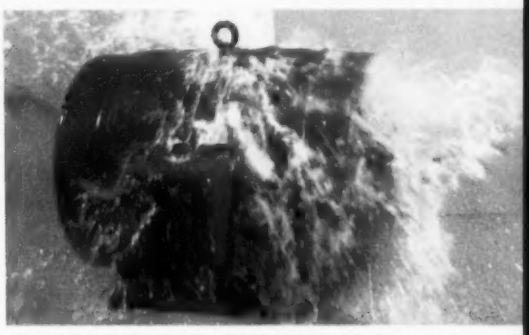
YOU GET
DOUBLE PROTECTION
against corrosion...
against falling
or splashing liquids



Air intakes and outlets are positioned to provide complete dripproof protection.



TYPE DP
1 to 125 hp



DOUBLY PROTECTED—Wagner DP Motors offer the *double protection* of completely dripproof enclosures and rugged cast iron frames that can take rough handling and resist corrosion.

with WAGNER TYPE DP MOTORS designed to meet more application needs

Wagner Type DP Motors offer the *double protection* of rugged corrosion-resistant cast iron frames and dripproof enclosures so well designed that the DP Motor can handle many applications that formerly required splashproof motors.

These Wagner Motors are built in the new NEMA ratings that pack more power in less space, are lighter in weight and are easier to maintain.

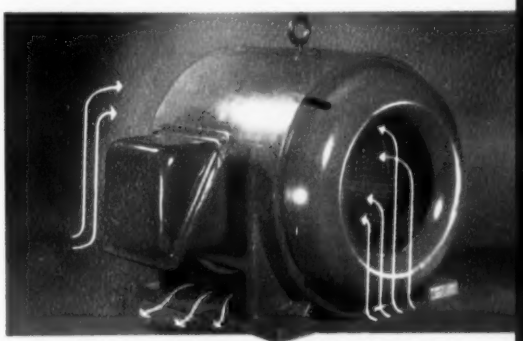


CAN BE RELUBRICATED—Factory lubrication will last for many years in normal service—but openings are provided to permit the relubrication that adds years to motor life under severe conditions.

SLEEVE BEARING MODELS AVAILABLE

The entire line of ratings through 125 hp is available with ball bearing construction as illustrated, or with steel-backed, babbitt lined sleeve bearings that have high load carrying capacity and provide quieter operation.

Let a Wagner Sales Engineer show you how these motors can be applied to your needs. Call the nearest branch office or write for Wagner Bulletin MU-223.



COOL RUNNING—Specially designed baffles direct cooling air through the motor to reduce stator temperature—thus increasing motor life. Blowers, cast as part of the rotor, move large volumes of air without noise or vibration.

1 to 125 HP—1750 RPM—40°C
NEMA FRAMES 182 through 445U

Wagner Electric Corporation
6400 Plymouth Ave., St. Louis 14, Missouri.

MS8-9

YOU GET
EXTRA PROTECTION
against corrosive... abrasive or explosive elements



TYPE JP
Explosion proof
1 to 100 hp

TYPE EP
Standard TEFC
1 to 100 hp

with Wagner totally enclosed motors... protected for longer motor life

If you need motors that will keep production rates up . . . that will give the continuity of service that is so important to automation . . . that will operate with complete dependability under the most severe conditions —Wagner totally-enclosed motors are your soundest choice.

Type EP Motors offer protection against corrosion, dust, abrasives, fumes, steel chips or filings. Type JP is explosion proof as well — designed and approved for use in explosive atmospheres.

NEW NEMA FRAMES—These motors are built in the new NEMA Frame sizes from 182 through 445U, with ribs that add mechanical strength and increase the surface cooling area. Effective cooling system adds to motor life.

Let your Wagner Sales Engineer show you how these protected motors can bring you savings on initial motor costs, maintenance costs and continuity of operation.

1 TO 100 HORSEPOWER—4 POLE, 60 CYCLE—NEMA FRAMES 182 THROUGH 445U

Wagner Electric Corporation

6400 Plymouth Ave., St. Louis 14, Missouri. Branches and Distributors in All Principal Cities

HEAVY DUTY BALL BEARINGS

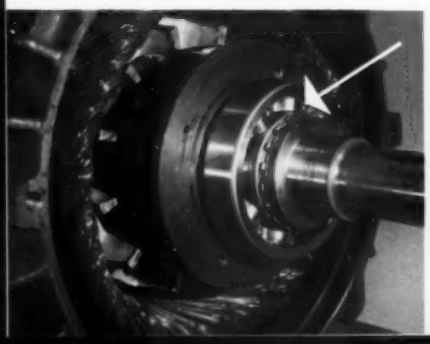
The ball bearings used in these motors are of the highest quality, with more than ample capacity to provide long troublefree service under heavy loads.

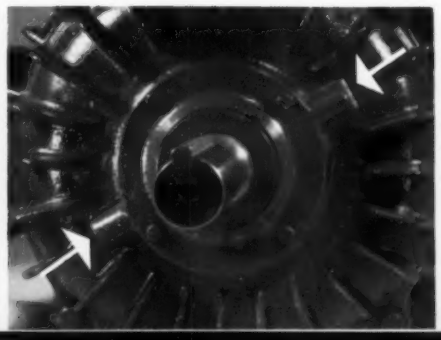
BEARINGS CAN BE RELUBRICATED

Factory lubrication will last for many years under normal service, but openings are provided to permit relubrication that adds years to motor life under severe conditions.

SEALS KEEP BEARINGS CLEAN

Both ends of these motors have running shaft seals to keep the bearings clean. Bearing housings are effectively sealed to prevent escape of grease.







Used by MORE CONTRACTORS than any other brand--

BY MILLIONS EVERY YEAR!

IDEAL

WIRE CONNECTORS

Best testimony to any line of products is who uses them — and why. For over 30 years contractors all over the USA have used more IDEAL Wire Connectors than any other kind — millions more every year. And now they're using more than ever! Why? Most likely because they've proved to themselves that IDEAL Connectors do a better job — are easier to use — and assure wire joints that unfailingly meet every standard for safety, permanence and quality wiring. This elminates high-cost call-backs due to faulty connections.

Use IDEAL Wire Connectors — most contractors do!



PRE-FABRICATED INSULATION FOR EASIER, BETTER JOINTS

IDEAL **CRIMP CONNECTORS with the "Wrap-Cap"** (Patented)

THE UNIQUE DIAPER-WRAP **INSULATOR**

SAFE . . .

"Wrap-Cap" gives you a joint better insulated than the wire itself . . . *all around* and between the wires and *double-wrapped* over ends.

STRONG . . .

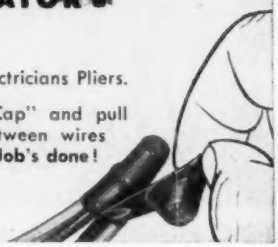
Cadmium-plated, *double-crimped steel* sleeve permanently locks wires into a cool, vibration proof, pull-proof joint with very low electrical resistance.

SIMPLE . . .



No special tool needed.

1. Crimp sleeve with IDEAL Electricians Pliers.
2. Apply "Wrap-Cap" and pull tabbed cap between wires and over joint. **Job's done!**



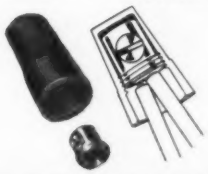
IDEAL **Wire Nuts®**

CONNECTORS

The 7-ways better screw-on connector with the WIRE-CRUSHING GRIP. Up to 2½ tons of pressure-force from screw-and-lever and wedge action flattens wires and multiplies contact. Just screw them on — like a nut on a bolt! Use new "Wire-Nut" wrench if you like.



IDEAL **Set Screw CONNECTORS**



Set 'em and see 'em! A screw driver's all you need. Permits visual inspection of every joint. A breeze to re-use when making circuit changes. *Solid brass* sleeve and set-screw — long-skirt, *highest dielectric* shell.

All IDEAL Wire Connectors in all contractor sizes are UL listed as pressure cable connectors, for general use (600 V.) in branch circuit and fixture wiring.

SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS

In Canada: Irving Smith, Ltd., Montreal

IDEAL INDUSTRIES, Inc.
1041-E Park Avenue, Sycamore, Ill.

IDEAL

Please send full catalog data on

☐ IDEAL CRIMP CONNECTORS ☐ IDEAL "WIRE-NUTS"
☐ IDEAL SET-SCREW CONNECTORS

Name_____

Company_____

Address_____

City_____ Zone____ State_____

Selected over 12



DAY-BRITE RECESSED TROFFERS are interchangeable with acoustical ceiling tiles, permit complete flexibility for the South Carolina Electric and Gas Co., Columbia, S. C. HEYWARD S. SINGLEY, F.A.I.A., *Architect-Engineer;* DUNN ELECTRIC CO., *Electrical Contractor.*

PROOF! No "or equal" can match Day-Brite!

Twelve different competitive fixtures were installed on a test basis in the new home of the South Carolina Electric and Gas Co. The architect and client each compared the fixtures *independently*, and both chose Day-Brite Troffers for the entire job.

Make your own comparison. Call your Day-Brite representative, listed in the Yellow Pages, for a demonstration. Compare Day-Brite fixtures side-by-side with any other fixtures at any price. Check features and value. Prove to your own satisfaction that Day-Brite fixtures have no "or equals."

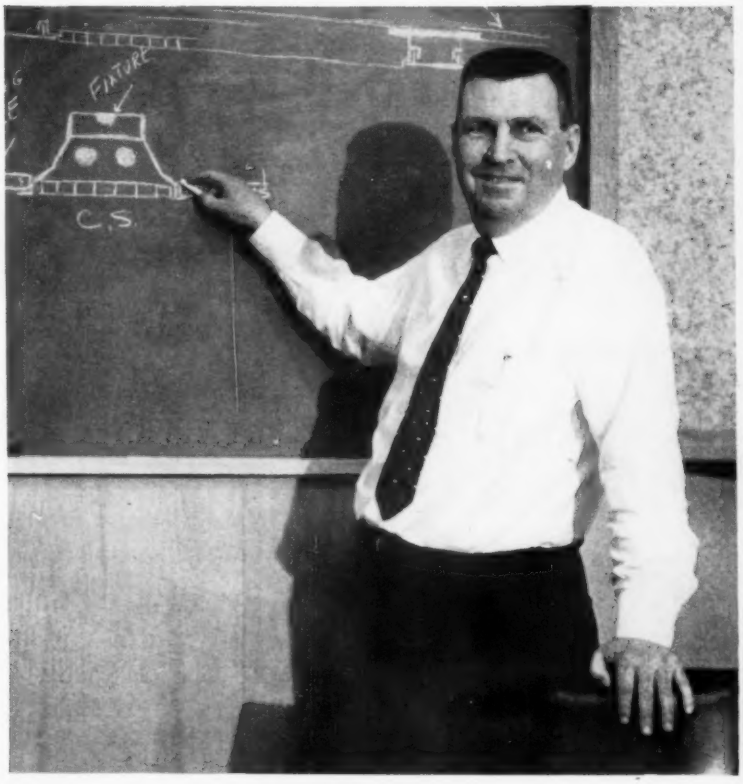


Additional light where it is needed!
Extra row of Day-Brite Troffers above business machines (next to wall) provide 85 footcandles at work level.

competitive fixtures!

DAY-BRITE...the Contractor's Choice





Chalk Talk by Joe Dunn

of Dunn Electric Co.
Columbia, South Carolina

"We pride ourselves on efficiency and up-to-date methods. And these are the qualities we appreciate most in Day-Brite fixtures.

"The time we might save or lose on a job is the toughest factor to estimate. And it can mean the difference between a profit or loss to us.

"That's why we appreciate the way Day-Brite equipment is designed, built and packaged . . . for ease and speed of installation. Day-Brite fixtures arrive securely packed. There's no breakage. Everything is there when you need it. There's no waiting for lost parts. And all component parts fit accurately . . . easily . . . to save time and labor."

Z-249

DECIDEDLY BETTER
DAY-BRITE
LIGHTING FIXTURES

Day-Brite Lighting, Inc.
6248 N. Broadway, St. Louis 15, Missouri
Day-Brite Lighting, Inc., of California
530 Martin Ave., Santa Clara, California

Certified Lighting for a Better America

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

Sherarduct
Rigid Steel Conduit

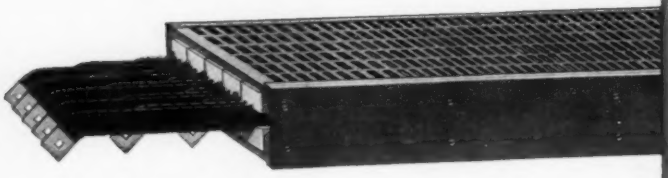


LOOK TO NATIONAL ELECTRIC FOR DEPENDABLE PATHWAYS OF POWER

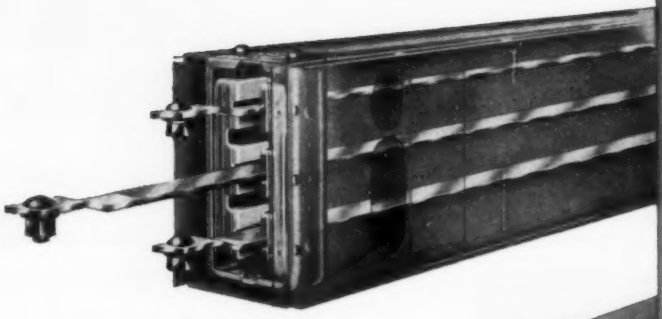
Xduct Junior E.M.T.



Lo-Loss Feeder Busway

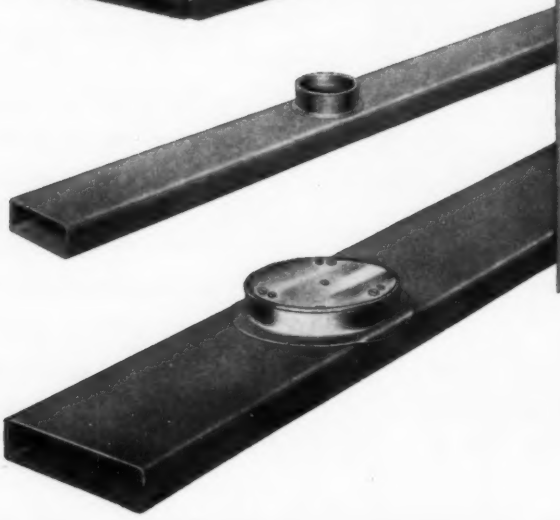


I.P.I. "Plug-in" Busway

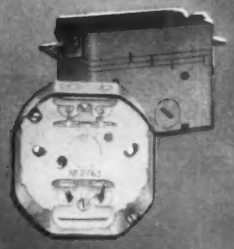


Nepcoduct
Underfloor Raceways

Headerduct
Underfloor Raceways



NATIONAL ELECTRIC PRODUCTS
WIRING SYSTEMS



"Redege" Boxes



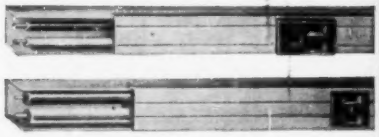
"800 Series" Floor Boxes

Wire and Cable—National Electric manufactures building wires and cables with every type of insulation and covering to meet the requirements of all industrial, commercial and residential wiring.

Metal Molding



"Plug-in" Strip



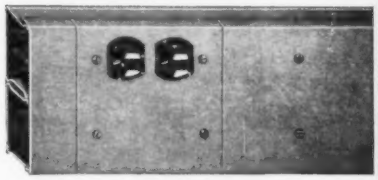
Baseduct



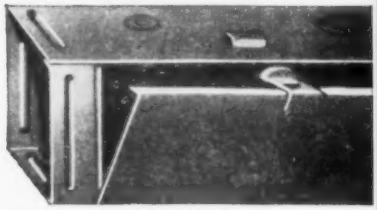
Surfaceduct



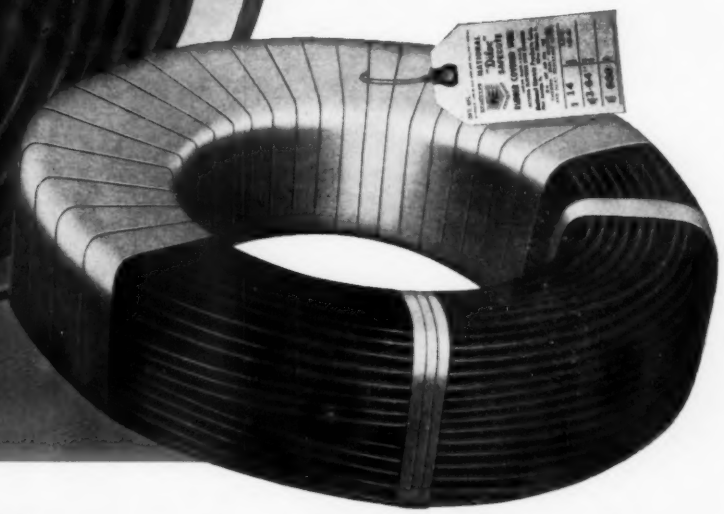
Twinduct



Wirewā



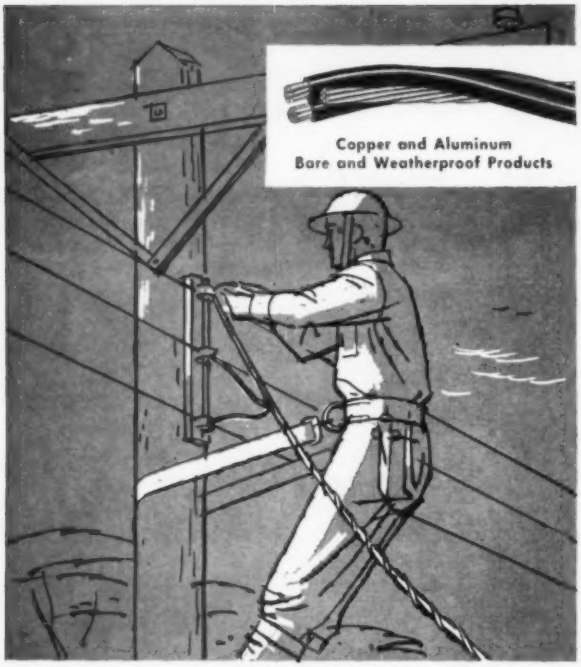




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Copper and Aluminum
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75°C. Wet or Dry

From Source to Service with ®

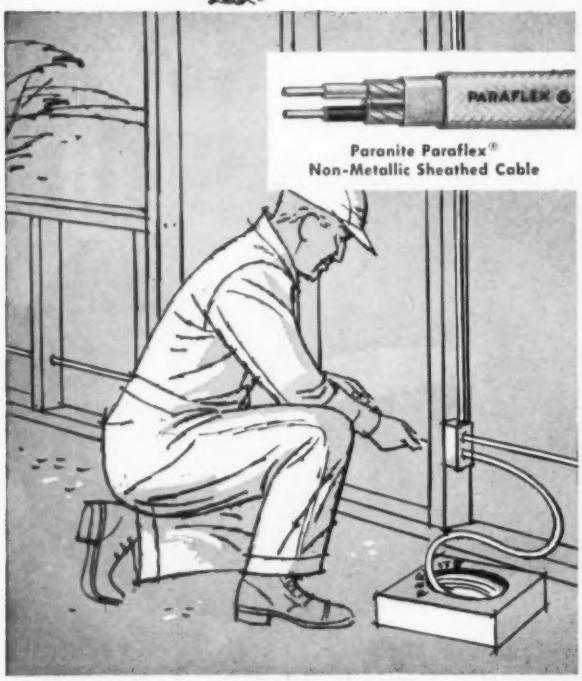
PARANITE

PARANITE WIRE AND CABLE DIVISION

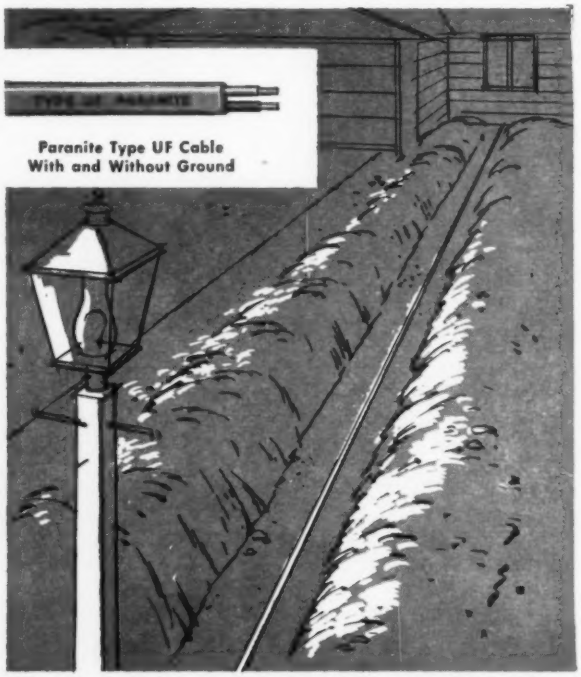
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FORT WAYNE 6, INDIANA

MANUFACTURING PLANTS: Birmingham, Alabama; Anaheim, California; Jonesboro, Indiana; Marion, Indiana; Tiffin, Ohio



Paranite Paraflex®
Non-Metallic Sheathed Cable



Paranite Type UF Cable
With and Without Ground

Sales Offices in all Principal Cities . . . Sold only through Recognized Electrical Distributors

THE NEW miller RICHMOND

...eaturing...

...uminous Texture-Lite Side Panels

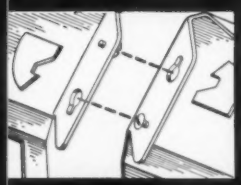
...lexibility of Design and Application

for SCHOOLS • OFFICES • STORES

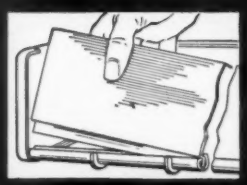


Unique, new decorative effects are possible with Texture-Lite side panels, a Miller exclusive, optional with Richmond. Open top lancings in the metal sides provide surface interest while shielding the lamps from direct view. Texture is accentuated and "brought to life" as light filters through the hooded openings. Appearance is softly luminous, subtle, and ever-changing. And with Texture-Lite the Richmond's clean, shallow styling is greatly enhanced.

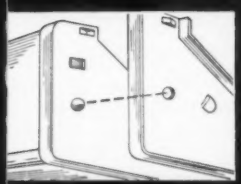
Only The Richmond Offers These Features!



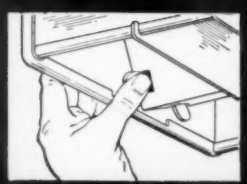
...IN CHANNEL CONNECTOR FOR ... UNITS . . . Facilitates continuous ...nstallation. Connector is part of ... strap. No loose parts.



"U" SHAPED, TRANSLUCENT PLASTIC SIDE RAILS . . . Seat side panels; secure cross louver ends. Keep shielding assembly rigid and rattle-free. No dark strips.



...MATIC ALIGNER CLIPS . . . Sim... alignment of shielding assemblies. ... on clip lines up with hole in ad... ...g end plate—no adjustments.



"TWIN" THUMB LATCHES . . . at each end provide easy accessibility from either side of fixture. Shielding assembly is securely held but easily detached.

Miller's new Richmond Series offers an exciting and unique combination of features to meet both aesthetic and functional lighting design needs for schools, offices, and stores. Shallow, straight-sided, and cleanly styled — these fixtures provide wide flexibility of design and application. Richmonds are well engineered, sturdily built, and *attractively priced.*

Truly coordinated design throughout any installation is made possible by a choice of: Decorative Texture-Lite, Opaque Metal, or Plastic Side Panels; two different shielding assemblies; and 2 or 4-Lamp units in 4 or 8-ft. lengths.

A subtle sparkle for added decorative effect is achieved on two of the Richmond units by means of a prismatic plastic strip. This strip provides 45° cross-wise shielding without increasing fixture depth.

For complete catalog information and performance data on the new Richmond contact your Miller Representative or write Dept. R-558, The Miller Company, Meriden, Conn.

THE miller COMPANY, MERIDEN, CONN.

In Canada: CURTIS LIGHTING OF CANADA LTD., TORONTO

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SINCE 1860



On the roughest SEALTITE electrica

against oil, grease, water dirt, chemicals, corrosive fumes, salt spray, weathe

SEALTITE is a flexible *and* liquid-tight electrical cond It gives maximum protection to your wiring when it m connect moving parts, absorb vibration, follow machine c tours, flex into U-bends, be easily maintained or be sa guarded between misaligned outlets.

It is being used successfully in wet locations, in tunn power plants, steel mills, canneries, chemical industries a in many outdoor applications. Sealtite comes in three typ

TYPE U.A.— TYPE C.S.A. Specifications for Type U. A. (Underwriters' Laboratories A proved) and Type C. S. A. (Canadian Standards Associati Approved). Construction: flexible galvanized steel co positive ground and tough extruded outer cover.

TRADE SIZE	INSIDE DIAMETER		OUTSIDE DIAMETER		APPR. INSIDE BEND	EST. WGT.
(Ins.)	Min.	Max.	Min.	Max.	DIAM.	(Lbs. Per 100 Feet
⅜	.484	.504	.690	.710	6	30.0
½	.622	.642	.820	840	7	36.6
¾	.820	.840	1.030	1.050	10	48.2
1	1.041	1.066	1.290	1.315	12	87.7
1¼	1.380	1.410	1.630	1.660	15	116.5

TYPE E. F.† (Extra Flexible)—for machine tools and industrial equipme (Meets standards set by J.I.C.)

TRADE SIZE	INSIDE DIAMETER		OUTSIDE DIAMETER		APPR. INSIDE BEND	EST. WGT.
(Ins.)	Min.	Max.	Min.	Max.	DIAM.	(Lbs. Pe 100 Fee
⅜	.485	.500	.695	.710	5	24
½	.620	.635	.825	.840	5	29
¾	.815	.930	1.035	1.050	6	39
1	1.030	1.050	1.295	1.315	8	67
1¼	1.370	1.390	1.635	1.660	10	87
1½	1.575	1.595	1.875	1.900	12	105
2	2.020	2.040	2.350	2.375	15	135
2½	2.480	2.505	2.850	2.875	20	198
3	3.070	3.100	3.470	3.500	26	282
4	4.000	4.040	4.460	4.500	34	414

Commercial tolerances apply on above figures.

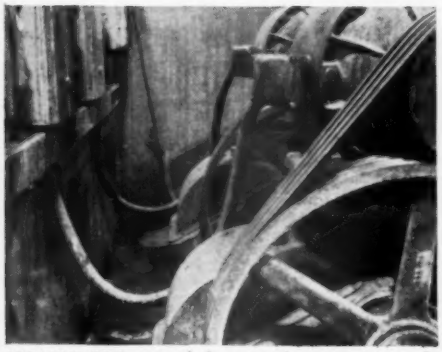
ELECTRICAL WHOLESALERS stock Sealtite. Buy it in long, ranc lengths on nonreturnable wooden reels, at no extra cost. Available sturdy cartons that are easier to store and carry to the job. Liquid-ti connectors also are available from wholesalers' stocks. For informat write: The American Brass Company, American Metal Hose Divis Waterbury 20, Connecticut. In Canada: Anaconda American B Ltd., New Toronto, Ontario.

†Pat. applied for

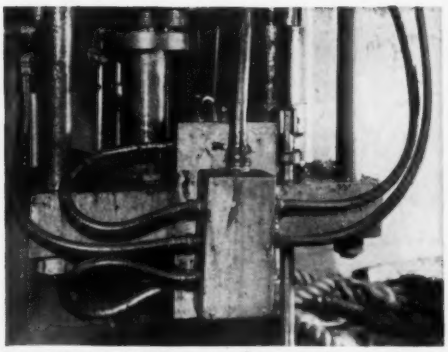




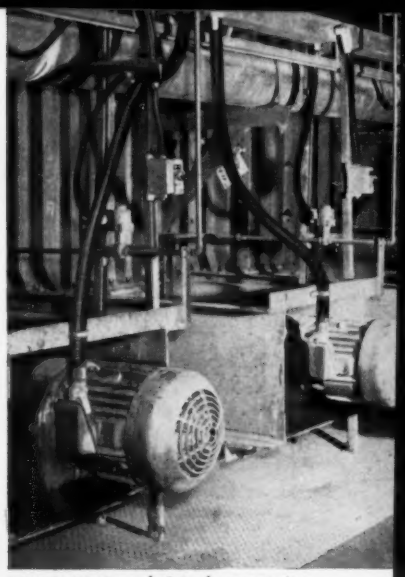
jobs in your plant conduit protects wiring



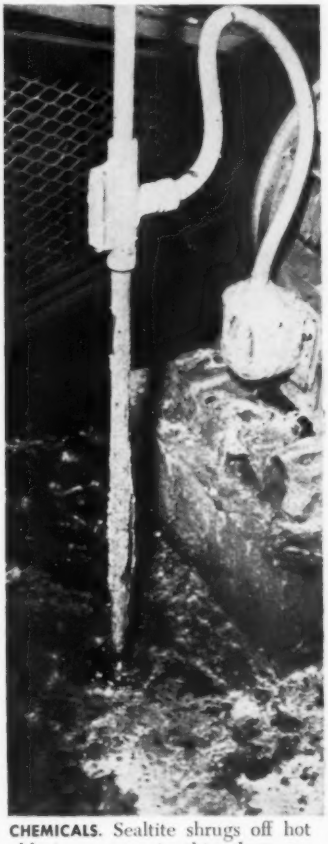
ABRASIVE GRIT around these sand pumps in a rod and ball mill pit can't faze Sealtite.



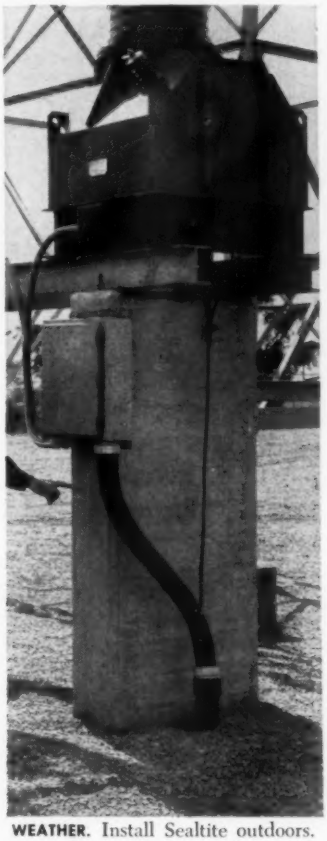
OIL, GREASE, WATER constantly cover these Sealtite control connections. Still no trouble.



BOILER HEAT and 6-inch expansion rise are easy service for Sealtite.



CHEMICALS. Sealtite shrugs off hot chlorine vapors in this plant—another example of its ability to resist chemicals and corrosive fumes.



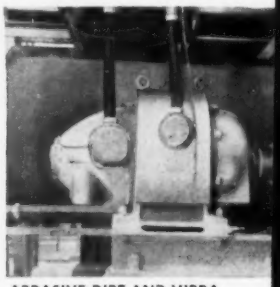
WEATHER. Install Sealtite outdoors. It stands up under tropical sun and heat, rain, ice, and arctic cold. Protection is complete.



ON MOBILE EQUIPMENT Sealtite can take up movement, withstands weather, dust, vibration. It's fast and easy to install.



MOVEMENT AND VIBRATION that would crack rigid conduit are absorbed by Sealtite on connections for these tailings pumps.



ABRASIVE DIRT AND VIBRATION at this ball mill motor are tough enemies—but Sealtite can take it.



CUTAWAY SECTION of Type U.A. Sealtite shows tough polyvinyl jacket over flexible metal core. Copper conductor wound spirally inside conduit gives positive ground.

Insist on the conduit marked **SEALTITE®**

FLEXIBLE, LIQUID-TIGHT CONDUIT

an **ANACONDA®** *product*

IT'S A SNAP!... to install PITTSBURGH'S NEW "SEE-WAY" LUMINAIRE



THERE'S A PERMAFLECTOR FOR EVERY PURPOSE

PITTSBURGH Reflector Company offers a complete selection of Fluorescent equipment—recessed, surface, pendant luminaires—to provide unlimited application and design possibilities. PITTSBURGH units are low in initial cost, easy to install and maintain, and give maximum operating efficiency through long service life.

For that next lighting job, remember to specify PERMAFLECTORS—the name that's symbolic with the finest silver-mirrored lighting equipment.

PLASTIC SIDE PANELS "SNAP" INTO PLACE

Here is a brand new feature that will save many hours of installation time . . . and greatly simplify panel removal for cleaning or replacement.

Side panels are flexible diffusing ribbed polystyrene . . . easy to handle, ship, and maintain. Light in weight, they reduce the ceiling load appreciably. They also add to the appearance and overall efficiency of the unit.

The light from the See-Way is glare-free, comfortable, easy to work under. Perfect for classrooms, offices, or wherever visual comfort is necessary to maintain peak working efficiency over long periods.

See-Way's low cost makes it easy on the budget too!

For other advantages on the SEE-WAY you ought to know about,

WRITE **FOR BULLETIN M-11.**



PITTSBURGH REFLECTOR COMPANY

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PITTSBURGH LIGHTING EQUIPMENT IS DISTRIBUTED BY BETTER ELECTRICAL WHOLESALERS EVERYWHERE



SERVICE ENTRANCE CABLE

UL-approved Kaiser Aluminum Service Entrance Cable is available for 75° wet applications! Improved design characteristics—including pleasing appearance and ease of application—make this cable your best buy.

Kaiser Aluminum & Chemical Sales, Inc., *Executive Office*, Kaiser Bldg., Oakland 12, California; *General Sales Office*, Palmolive Bldg., Chicago 11, Illinois.

KAISER ALUMINUM



L. C. Marschall, Executive Vice President, discusses the general management viewpoint on "conservative design"

"What we claim for Sola Mercury Lamp Ballasts they will do . . . and then some"

It's usually quite difficult to find a comfortable position seated out on a limb. We, at Sola, avoid this unenviable position by making sure our mercury lamp transformers perform as we claim they will, plus an adequate margin of safety.

Any Sola Mercury Lamp Transformer will consistently exceed the product claims of operation we make for it. There is no doubt that we could make stronger statements and still be within the limits of the transformers' capabilities. We prefer, however, to keep our claims conservative and straightforward. This is in keeping with our policy of conservative design which is prevalent throughout Sola's entire line of products.

For example, we state that our ballast for one 400-watt mercury lamp has an efficiency of 89.2 percent. This is conservative. If anyone claims higher efficiency than this, we prefer it be you — after you've had experience with the operation of this constant wattage mercury lamp transformer.

Write for your copy of Bulletin 17E-MV-306

Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill., Bishop 2-1414 • Offices in principal cities • In Canada, Sola Electric (Canada) Ltd., Canmotor Ave., Toronto 14, Ont.





ALUMINUM
OR GALVANIZED STEEL
SUPPORT SYSTEMS
FOR POWER AND CONTROL CABLES
IN-FREE-AIR
DESIGNED AND DEVELOPED BY HUSKY PRODUCTS

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HUSKY
CABLE SUPPORT SYSTEMS
are NOT ONLY
RECOMMENDED and APPROVED
by ALL Leading
CABLE MANUFACTURERS
They are actually SOLD by MOST of the large cable manufacturers.

NO OTHER
POWER CABLE SUPPORT SYSTEM HAS THIS DISTINCTION.

DO YOU KNOW WHY??
The only "electrically sound" system; let us explain... or... ask your cable manufacturers representative.

ALSO...
Send for your copy of the story of
"CABLE IN-FREE-AIR"

please remember
these famous words;

"There is hardly anything in this world that some man cannot make a little cheaper—and a little worse . . ."

Specify:
HUSKY
OR APPROVED EQUAL
and be certain that YOUR approval gives your client . . .

- A sound electrical system
- A sound mechanical system
- A coordinated system with unit responsibility
- An economical job—the lowest "installed cost"
- A system adequate for indoor or outdoors, for long spans and ideal for future expansion

Design and layout assistance available

Over 4,000 major installations—
SEND FOR CATALOG.

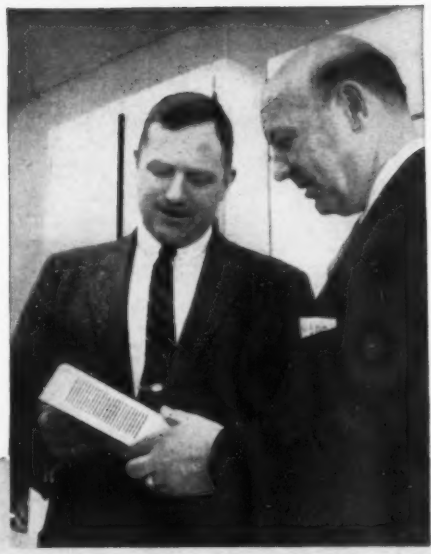
AVAILABLE THROUGH LEADING CABLE MANUFACTURERS

HUSKY PRODUCTS, INC.
5300 VINE STREET, CINCINNATI 17, OHIO

This is a contractor.

"We sold up...to triple the sale per house"

Here's contractor Ray Butz, who believes you close more often when you sell up. And here's how he got results, selling a door chime and fire alarm package for the 6,000-home Elk Grove Village development.





When closing time came for the entire electrical installation including the chime and fire alarm package, Ray Butz (briefcase) and his partner Len Aldridge (dark hat, galoshes) took Aldridge's private plane to fly down to the builder's home office in Dallas, Texas.

"A stripped-down proposal leaves you nothing to sell but price," *says Ray Butz. "And there's always somebody hungry enough to cut you out for a few pennies less per unit. But when you sell up, you sell the builder all the benefits he can get from a better installation. You sell product features, and you sell your quality installation and service. You make more sales and each one is bigger."*



Door chimes for 6,000-home Elk Grove Village development—how Ray Butz tripled the sale per house.

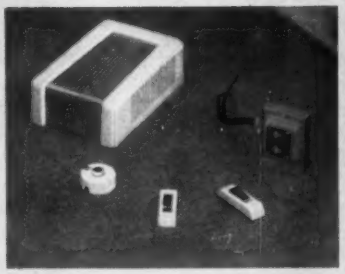
Butz finds that selling up takes three things: the right "package" proposal, cooperation with the electrical distributor, and demonstration (not just sales talk) to the prospect. Centex Construction, now building 6,000 homes in Elk Grove Village, Illinois, first wanted only an inexpensive door chime. Ray Butz and Len Aldridge, his partner in A&B Electric, developed a package proposal that included push buttons, transformer, fire-warning thermostats, and a better, higher-priced chime.



"Demonstration is what turned the trick," Butz says. Working with distributor Bob Fink of Interstate Electric Supply, Butz created a portable demonstrator, with every piece of equipment mounted and wired. Bob Fink is also skillful at selling up. As he points out, "We originally included two thermostats in the demonstrator, because we feel that you can always reduce a proposed package, but can seldom add."

"You need close cooperation with the distributor," says Butz. "In developing this chime and fire alarm package, Bob Fink of Interstate helped us all along the line. Not only that, but all through the job we rely on him for sales help as well as supplies. He takes the grief off our inventory by stocking the items we might need, and by carrying a buffer stock on factory-shipped items, large enough to prevent delays. He also gives us information, the latest word on new sales approaches, new installations and applications."

Here's what RAY BUTZ sold up with



The chime is Edwards' top-selling Bolero III. Ray Butz' portable demonstrator displayed the attractive "decorator" features of the Bolero III, and was wired so that one modern Edwards "Keynote" push button rang the front-door two-note melody, while the second push button sounded the back-door one-note.

The Edwards "Heatguard" thermostats, U.L. listed, were wired so that a lighted match or cigarette could be used to activate them as a demonstation, and thus ring the continuous *Vibrechord* third signal on the Bolero III chime. The Centex development in Elk Grove Village is now using one of these thermostats in the ceiling of the utility space that encloses the heating plant in each house.

The U.L. listed Edwards #890 transformer is one of an entire line that saves labor for contractors because the transformer mounts fast, through a knockout in any standard box, just by tightening the *single* screw located *outside* the box.

The Edwards Company believes that contractors have an important but sometimes underrated job to do in the electrical industry. Often we run across men in contracting, like Ray Butz of A&B Electric, who are doing their job very well indeed. We're glad to be able to relay their ideas.

EDWARDS

Specialists in signaling since 1872

Edwards Company, Inc.,
Norwalk, Connecticut
(In Canada: Edwards of Canada, Ltd.,
Owen Sound, Ontario)

up, UP again!

. . . goes every INDUSTRIAL LIGHTING UNIT SPECIFICATION in the NEW RLM BOOK



NEW *specifications for Special Service fluorescent units!*

NEW *specifications for units utilizing 800 ma. fluorescent lamps!*

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NEW SPECIAL SERVICE UNITS feature one-piece, all-porcelain enamel, housing to withstand ... dusty atmosphere.

NEW ... UNITS ... specify ... for 800 ma. ... escent lamps ... that produce 40% more light.

NEW INCANDESCENT SPECS for industrial units include an increase in number of available sizes; additional applications.

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Please send me a copy of the new upward-revised RLM Specifications Book—I understand there is no cost or obligation on my part.

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Address .....

City ..... Zone ..... State .....

YOUR BASIC ASSURANCE OF HIGH QUALITY



This label identifies the RLM-certified lighting equipment of 26 leading manufacturers

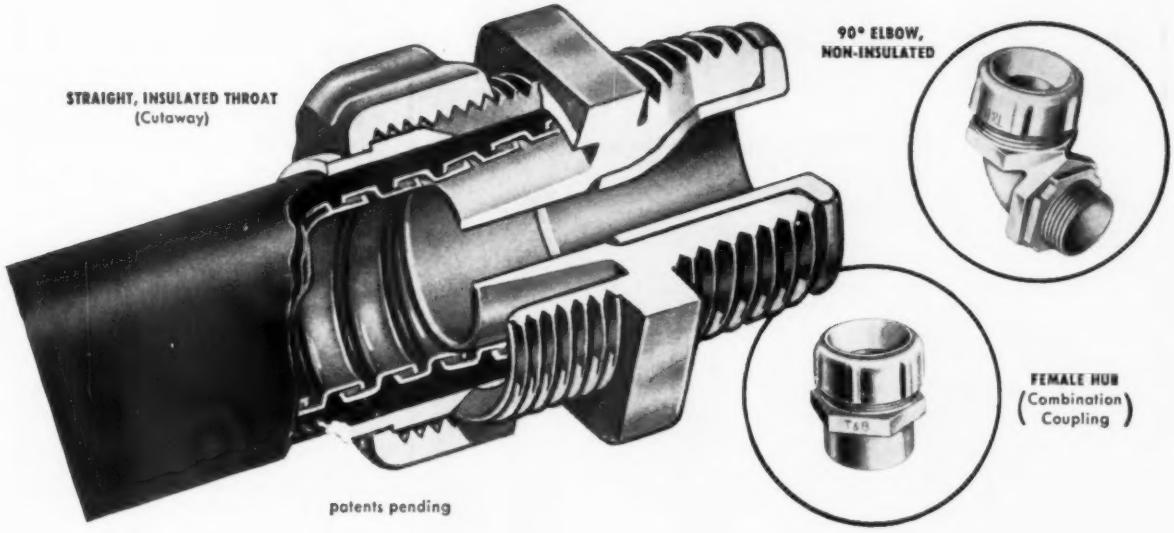
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R-234

ONLY T&B CONNECTORS

*for flexible liquid-tight conduit**

OFFER ALL THESE ADVANTAGES



patents pending

THE T&B LINE provides a size range of ⅜" to 4" in the straight, 45° and 90° angle types . . . both insulated and non-insulated.

THE T&B LINE includes combination couplings from ⅜" to 1¼".

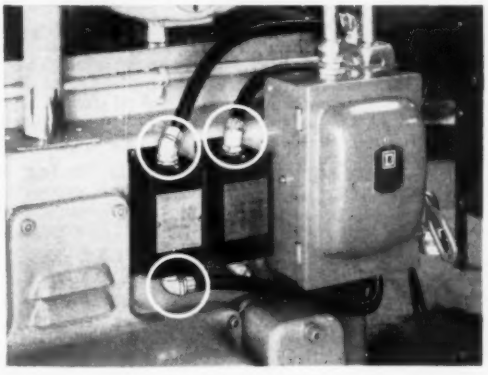
A T&B Liquid-Tight connection can't be half safe. The mechanical strength, continuity of ground, and oil seal are all interdependent. Each gives positive assurance that you have all three. And T&B's more compact design means easier installation and improved appearance.

Your T&B distributor has this complete line in stock. Be sure to ask for a demonstration . . . or write direct to T&B for detailed specifications.

* *Sealtight or equivalent*

THE T&B INSULATED LINE complies with all codes:

The National Electric Code (Paragraph 3736b)
J.I.C. Standards (Paragraphs 22.1.7 and 22.2.2)
Machine Tool Electrical Standards (Paragraph 22.1.7)



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The complete line of T & B fittings for conductors and raceways is sold only by recognized electrical wholesalers. It's our way of assuring you the service and savings of a friendly local source. Call him for all your electrical needs.

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THOMAS & BETTS, LTD., MONTREAL, P. Q., CANADA
MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898

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TO BE SURE—SPECIFY EAGLE FUSES



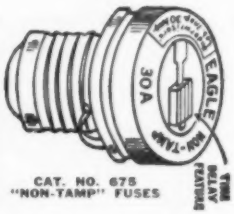
CAT. NO. 690 "OK" FUSES



CAT. NOS. 660-661 "SLO-LAG" RENEWABLE FUSES AND LINKS



CAT. NO. 670 "SLO-LAG" FUSES



CAT. NO. 675 "NON-TAMP" FUSES

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CAT. NOS. 655 & 656—250V and 600V NON RENEWABLE CARTRIDGE FUSES

THERE'S AN EAGLE FUSE FOR EVERY PURPOSE

Eagle makes a complete line of fuses . . . and all of them are built to reflect the Eagle slogan that "Perfection is not an Accident". Let's look at some of the leading fuses in the Eagle line, fuses for most every type of circuit.

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"OK" Glass Fuse . . . here's the famous fuse that "speaks for itself". Its exclusive "OK" feature positively indicates when it blows, and it indicates overload or dead short as well. Available from 10 amp. to 30 amp., each with colored discs that make for easy and quick identification of amperage. Also available in sub-standard sizes.

CAT. NO. 675

The Eagle Non-Tamp Fuse (Type S) . . . prevents tampering and overfusing. Equipped with a thermal element, they provide a time lag that prevents needless blowing on temporary loads. "Non-Tamp" fuses have a different shaped base than ordinary fuses, and this makes it impossible to insert too large a fuse, such as a 20 or 30 amp. Non-Tamp fuse in a 15 amp. receptacle.

CAT. NO. 670

"Slo-Lag" Plug Fuses . . . prevents needless fuse blowing. The Eagle "Slo-Lag" plug fuses have been especially designed to prevent unnecessary fuse blowing caused by temporary overloads in appliances and other equipment. They provide full instant protection on dangerous overloads and short circuits. Available in 15, 20, 25, and 30 amp. sizes.

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Eagle "Slo-Lag" Renewable Fuses . . . provide protection on circuits to 600 amps. Simple in design, they provide rigid construction and perfect venting.

CAT. NOS. 655 and 656

"Non-Renewable" Cartridge Fuses by Eagle . . . are available, too, up to 600 amps. And Eagle also has a handy and neat Pocket-Type Fuse Puller that's designed for safe and easy use.

Eagle is America's best line of fuses, and it's because they build dependability into each and every fuse.

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LONG ISLAND CITY 1, NEW YORK

"PERFECTION IS NOT AN ACCIDENT"

of program material by a neon indicator and provide for aurally monitoring program material from an external speaker. (A)

16. Aurally (Monitor speaker) and visually (meter) monitor program material. (BCD)

17. Provide for an EMERGENCY switch that shall (1) turn on the system, if off; (2) Indicate a red panel lamp when system is ready for operation; (3) Provide precedence by disconnecting all program sources and preset volume level; (4) Permit distribution of an emergency announcement by means of the monitor speaker to all rooms simultaneously—regardless of other control or switch settings. (ABCD)

18. Transmit program material to all speakers simultaneously, regardless of room speaker switch settings, by placing the function switch in the "ALL-CALL" position. (ABCD)

19. Select and preset any number of room switches before distributing program material. (ABCD)

20. Provide means to record any program material on an external tape recorder. (ABCD)

21. "Preview" and adjust program material through the console monitor speaker before transmission to room speakers. (ABCD)

22. Distribute a raucous tone signal from built-in oscillator to any combination of room speakers. (ABCD)

23. Adjust volume of console output from a remote location. (ABCD)

24. Receive a reply from a classroom only with the knowledge and active assistance of the teacher—thereby assuring "privacy". (BCD)

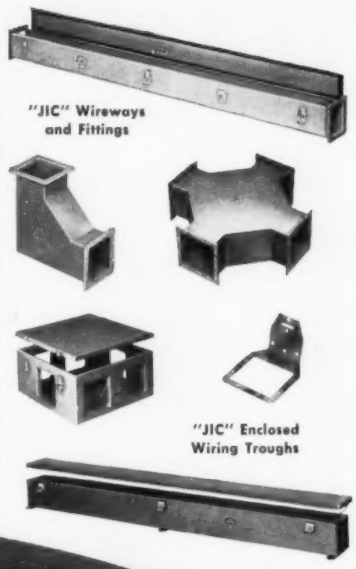
25. Provide means at the console to aurally and visually indicate room(s) which wish to communicate with the console. (BCD)

26. At each location shown on the plans, there shall be installed a special "RED" telephone handset which when lifted from the cradle shall (1) Turn "on" the system, if "off"; (2) Indicate by means of a red lamp in thecradle when system is ready for operation; (3) Provide precedence by disconnecting all other program sources; (4) Permit distribution of an emergency announcement from the handset to all rooms simultaneously—regardless of position of console switches and controls; (5) Provide audible signal in handset to indicate message is being distributed. (ABCD)

27. Same as above but add: (6) By

(*Continued on page* 228)

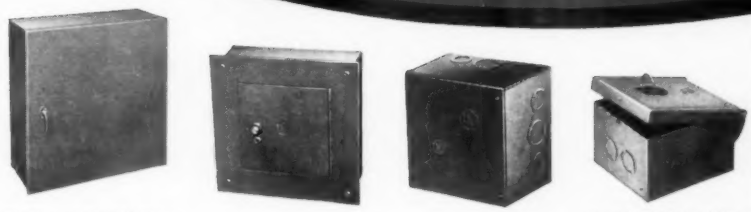


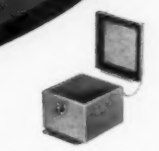


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ECM5

11.0 Signal

pressing momentary switch in handset cradle, distribute a siren tone to all rooms simultaneously. (ABCD)

28. By actuating one of several remote-emergency alarm switches it shall be possible to automatically perform the following: (1) Turn "On" the system (if "off"); (2) Provide precedence by disconnecting all other program sources; (3) Distribute a siren tone to all rooms simultaneously, regardless of the position of the console switches and controls. (ABCD)

29. Provide facilities for a selective ringing, selective talking telephone system without the use of additional wiring between the console and room(s). (ABCD)

30. Provide for the generation and distribution to all classroom speaker(s) simultaneously, of a tone signal keyed by a single circuit program instrument supplied on another contract, for indicating beginning and end of classroom period. (ABCD)

31. Provide for the generation and the distribution of a tone signal to classroom speakers for indicating beginning and end of classroom period. Circuit shall provide for connecting speaker lines as desired through a cross connect panel to a two, four, or six circuit program instrument supplied on another contract. (ABCD)

32. Provide facilities for priority control of speakers connected to remotely located independent public address systems. (ABCD)

11.33 Equipment

A. Central Control Console

All sections of the console cabinet shall be constructed of cold rolled No. 16 gauge steel and finished in gray metalustre enamel. The cabinet shall measure —— high by —— wide by —— deep and its front face shall slope at an angle from its vertical plane. The unit shall be provided with a working desk surface. The console shall mount all switches, controls and indicator lights (where necessary) for the proper operation of the system.

1. Program Channel Preamplifier and Mixer (One for Single and Two Channel Systems and Two for Three Channel Systems).

The preamplifier shall have facilities for selecting and mixing program material from two microphones and one other program source (Radio, Phono, Remote No. 1, Remote No. 2, Tape or Room Pickup) for distribution to

(*Continued on page* 230)

(*Advertisement*)

NOW—CADWELD Electrical Connections for Aluminum

Latest news in the electrical industry is ERICO PRODUCTS, INC.'S new thermit type welded aluminum connection. Similar to their copper CADWELD PROCESS, NEW connections can be made on aluminum cable to: cable, lug, bus, surface or tube; bus to bus and bus to lug or tube. Also available are transition joints of aluminum to copper.

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New catalog gives technical, instructional and ordering information on over 30 basic type connections. With the growing acceptance of aluminum as an electrical conductor, CADWELD ALUMINUM CONNECTIONS now solve the most difficult problem—a high quality electrical connection.



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2070 E. 61st Place Cleveland 3, Ohio

VERSATILITY sells CADWELD electrical connections

CADWELD electrical connections have 5 basic outstanding features:

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BESIDES THESE FEATURES IS A SIXTH MAJOR POINT THAT OUTSELLS ALL FIVE — *VERSATILITY*

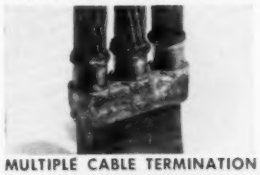
Once any customer has made a CADWELD electrical connection he knows the process. From that point, the only change is in the individual mold design. Todays catalog, lists over 58 basic types of connections—one year ago, there were only 32. The specials have become standards, because our customers approve the high quality of CADWELD and request it on new applications every day.

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★ Engineered for uniform design and easy installation
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These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants, in modernization, and for power distribution in all types of manufacturing processes. A new catalog, just off the press, gives full information and installation techniques. Ask for your FREE copy today.

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109

PRODUCTS DIVISION

The **GLOBE** *Company* MANUFACTURERS SINCE 1914

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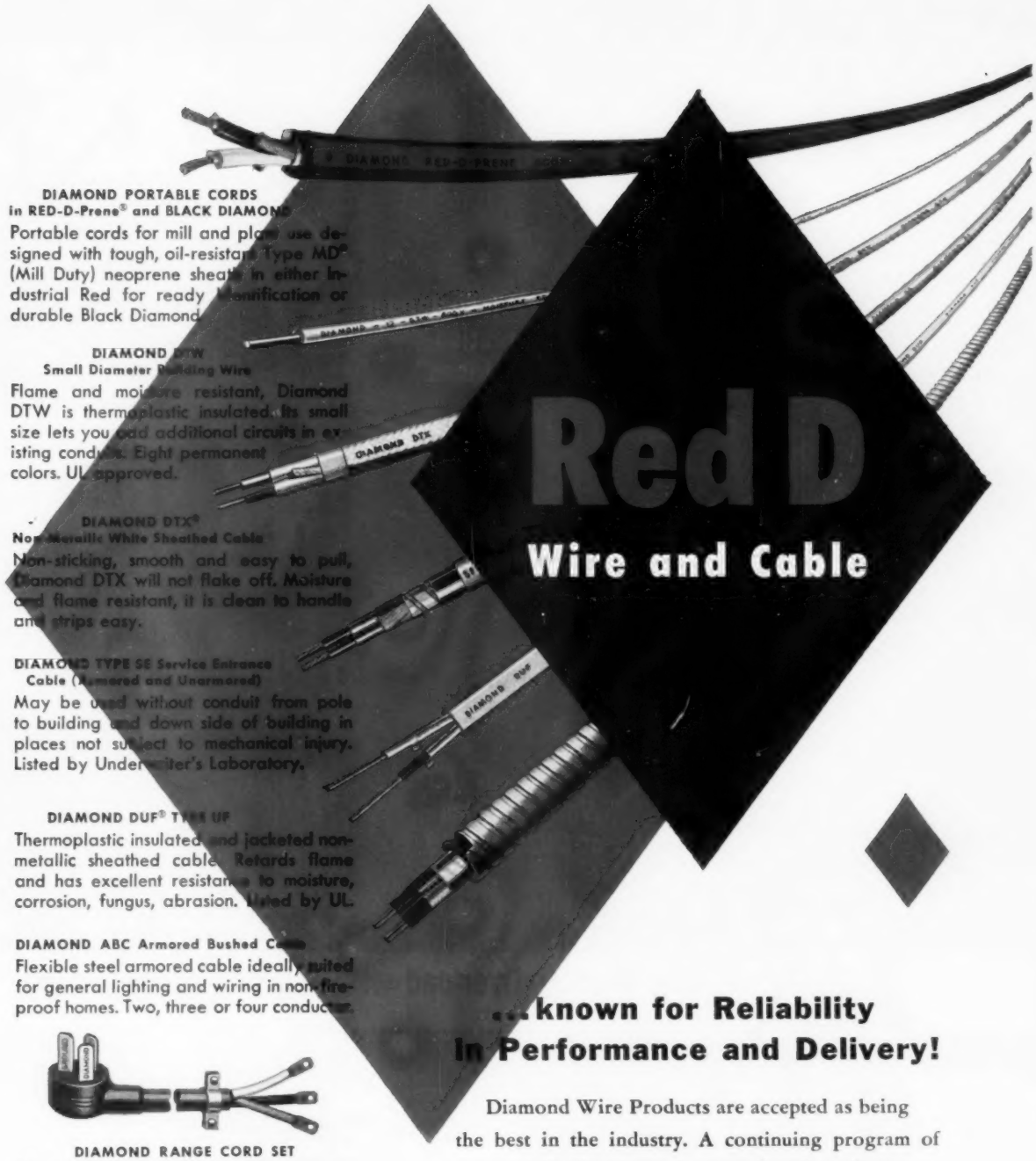
booster amplifiers. The unit shall incorporate an output function selector switch and its use shall permit the pre-selection of program material before distribution to any room speaker, permit distribution of program material to all room stations simultaneously regardless of the position of the output selector switches; in the emergency position, this switch shall cut off all program material and shall permit announcements to be made to all speaker stations regardless of any control settings. Receptacles shall be furnished on the front panel for the local microphone, tape playback and tape record inputs. Pilot lamps shall clearly indicate "Power On" and "Emergency Ready". The panel shall measure —— high by —— wide, and shall be attractively finished in grey metalustre with all controls and all switches clearly labeled. The preamplifier shall meet the following minimum specifications: Frequency response shall be from 50 to 15,000 cps ±2 db. Hum and noise shall be −60 db below rated output, and its gain shall be 60 db across 100,000 ohms load for 5-volt output. Treble control action shall be plus 8.5 db to −10 db at 10 kcs, and the bass control circuit shall permit control from plus 12 db to −11 db at 60 cps.

2. Intercommunication - Auxiliary Channel Control Panel

The Intercom-Auxiliary channel shall have provision for inputs from a radio tuner, phonograph, tape recorder, a 600 ohm input from two remote lines and a 50 ohm input from a local microphone. It shall be designed to operate with an intercommunication amplifier rated at (10 or 30) watts. The unit shall have four controls, logically grouped and interrelated; Monitor selector (Chan "A", AUX, Chan "B"); Monitor volume, Program group selector (Radio, Phono, Remote No. 1, Remote No. 2, Tape) Aux-Volume, Function Selector (Local Mic, Aux, Talk-Listen (Talk-Listen position shall be spring return), Power Switch. The panel shall also incorporate a db meter and monitor speaker, which shall also be utilized for the intercommunication function. The meter shall indicate the level of the output signal from either the program preamplifier (2) or intercom-auxiliary channel.

3. Program Amplifier(s) (one required for ABC and two required for D)

(*Continued on page* 234)



DIAMOND PORTABLE CORDS
in RED-D-Prene® and BLACK DIAMOND

Portable cords for mill and plant use designed with tough, oil-resistant Type MD® (Mill Duty) neoprene sheath in either Industrial Red for ready identification or durable Black Diamond.

DIAMOND DTW
Small Diameter Building Wire

Flame and moisture resistant, Diamond DTW is thermoplastic insulated. Its small size lets you add additional circuits in existing conduits. Eight permanent colors. UL approved.

DIAMOND DTX®
Non-Metallic White Sheathed Cable

Non-sticking, smooth and easy to pull, Diamond DTX will not flake off. Moisture and flame resistant, it is clean to handle and strips easy.

DIAMOND TYPE SE Service Entrance Cable (Armored and Unarmored)

May be used without conduit from pole to building and down side of building in places not subject to mechanical injury. Listed by Underwriter's Laboratory.

DIAMOND DUF® TYPE UF

Thermoplastic insulated and jacketed non-metallic sheathed cable. Retards flame and has excellent resistance to moisture, corrosion, fungus, abrasion. Listed by UL.

DIAMOND ABC Armored Bushed Cable

Flexible steel armored cable ideally suited for general lighting and wiring in non-fireproof homes. Two, three or four conductor.

DIAMOND RANGE CORD SET

Diamond three-wire range cord sets are 36" long. Have rubber molded cap, molded on rubber jacketed cable—are complete with steel strain relief. UL approved.

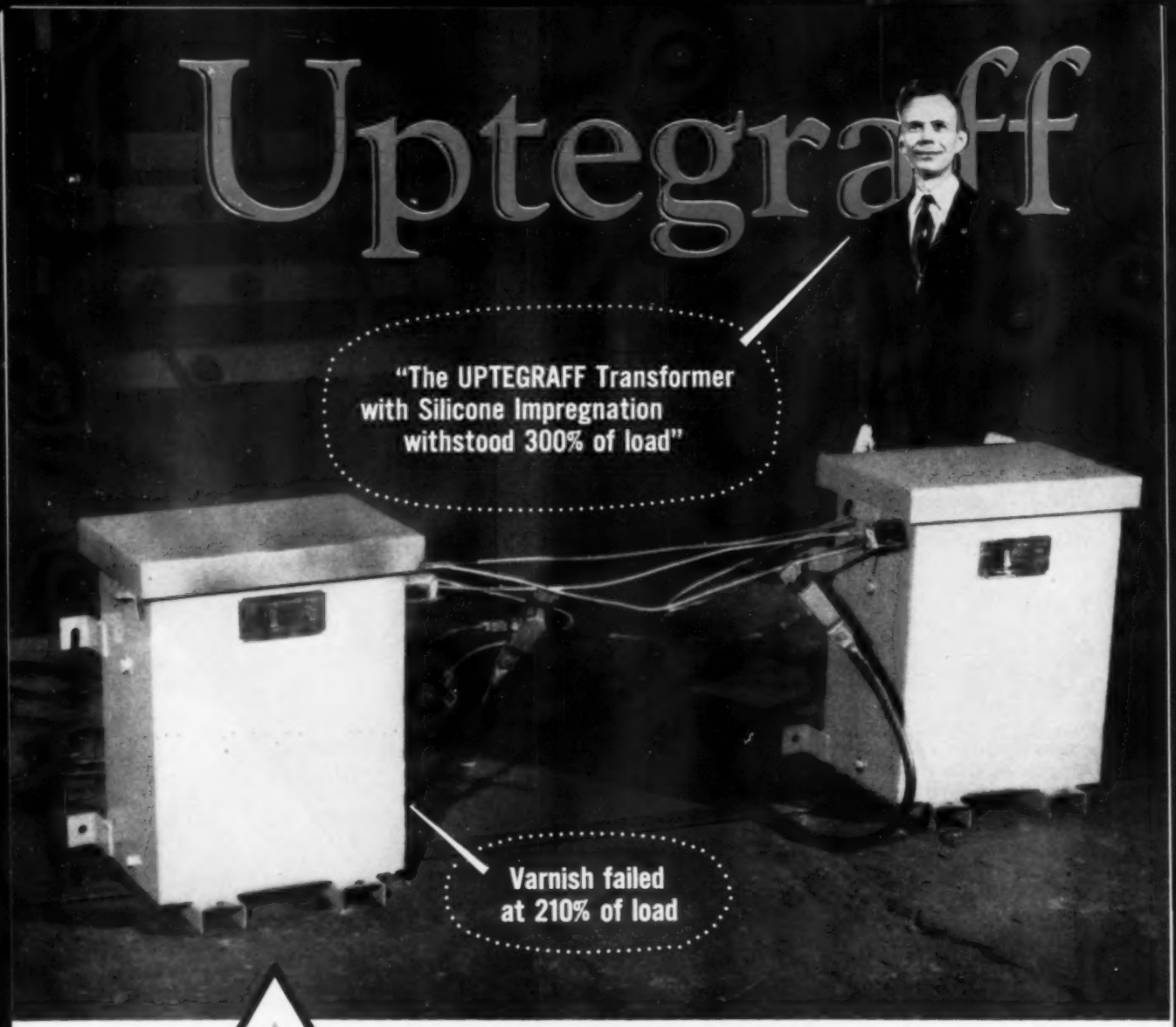
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Diamond Wire Products are accepted as being the best in the industry. A continuing program of production control, research and product development helps maintain this reputation. And when your order for a Diamond product comes in . . . the goods go out, promptly and with no delay.

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WIRE AND CABLE COMPANY
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Uptegraff



40% Greater Overload with Silicone Impregnation

Unique Design Features of Major Models



Type H...
3-10 kva

Small, wall-mounted
Silicone impregnated,
Class H insulation
Totally enclosed (dust-tight)
Accessible clamp-type terminals

Announces...

SILICONE IMPREGNATION of Class B Dry Type DISTRIBUTION TRANSFORMERS

Anticipating tomorrow's higher performance standards and increased power requirements, Uptegraff is now producing all of its Class B Dry Type Distribution Transformers, 112½ kva and smaller, with Silicone-impregnated windings.

Overload tests—after extensive research in insulating materials—conclusively prove that transformers with Silicone Impregnation withstand up to 40% greater overload than ordinary varnish, and provide superior moisture resistance and freedom from embrittlement and cracking with age. Organic varnish used by most manufacturers for Class B 80°C transformers degenerates with time and has less thermal stability, while the inorganic Silicone type insulation provides much higher temperature-resisting characteristics.

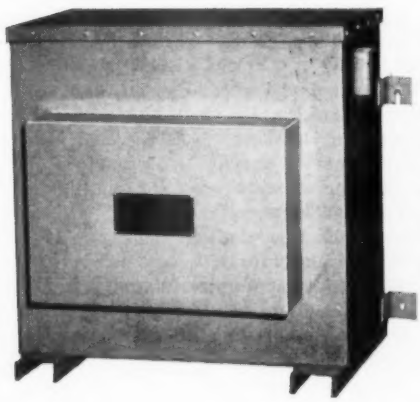
In the comparative test seen on the left, transformers rated for Class B 80°C temperature rise were started with a full rated load. This load was increased by 20% increments and each increment was held until the temperature remained steady. The varnish failed at 210% of rated load while the Silicone-impregnated insulation withstood 300%.

New Bulletin Gives Complete Details...

Bulletin 137 provides additional advanced design features of Uptegraff dry type distribution transformers, 3 kva to 500 kva inclusive, 4800 volts and less. Write for your copy *today*.



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Type DH & DHT ...15-112½ kva

Junction box for leads and taps
Silicone impregnated, Class H insulation
Totally enclosed (suitable for outdoors)
Flexibility as to mounting
Low sound level



Type DB & DBT ...3-112½ kva

Silicone impregnated, Class B insulation
Ceiling, wall or floor mounting
Metal and porcelain terminal boards
High voltage and low voltage separated on voltages over 600

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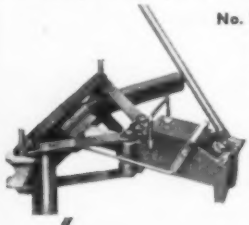
TIMESAVING HYDRAULIC CONDUIT BENDERS



No. 884 Hydraulic Power Bender for conduit sizes ½" - 4". For faster, easier 90° bending of conduit in ten sizes up to 4" . . . *makes full 90° bend with one ram stroke.* Operated with the GREENLEE No. 798 Power Pump as shown here, the GREENLEE No. 884 Power Bender bends 4" conduit or pipe 90° in just four minutes . . . makes same bend in only thirty seconds with No. 797 Power Pump. Develops 40 tons ram pressure — yet high-strength aluminum and steel construction reduces weight to minimum. Easily wheeled from job to job on pipe supports specially designed to serve as rollers. Operates in any position. Conduit is inserted and removed from front . . . one pair of universal pipe supports rotates to handle all pipe sizes . . . a dozen special features place this new bender in a class by itself for versatility, speed, and ease of setup and operation by one man.

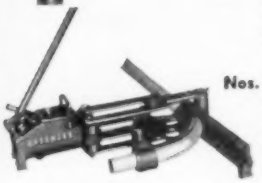
No. 880 Lightweight Hydraulic Bender for conduit sizes ½" - 2". Makes full 90° bend with one ram stroke . . . assures uniformity of bends in pipe and conduit of ½" through 2" sizes. One man easily carries and operates the GREENLEE No. 880 Hydraulic Bender . . . simplified quick setup. Ram fits GREENLEE thin-wall conduit, tubing, and bus-bar bending attachments. Designed for easy hand-pump operation, the No. 880 also teams with a GREENLEE power pump for production jobs.





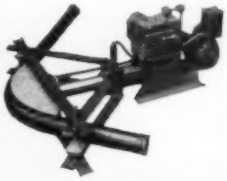
No. 770 Hydraulic Bender for conduit sizes 1¼" - 3". Maximum piston pressure of 25 tons for fast, easy bending. One-man operation. Easily operated by hand or a power pump, the No. 770 Bender makes fast, smooth bends without the use of heat or filler. Extra attachments available for bending ½", ¾", and 1" sizes.

No. 775 Hydraulic Bender for conduit sizes up to 5". Similar to the No. 770 Bender, but is designed to bend larger size conduit and has a maximum pressure of 40 tons. Will easily make smooth, precise bends in cold conduit and pipe. Either hand- or power-pump-operated. Shoes and supports available for this machine make it possible to bend eight sizes of pipe from 1¼" to 5".



Nos. 770-T and 775-T Thin-Wall Hydraulic Conduit Benders. GREENLEE No. 770 or 775 Power Unit with attachments to make a full 90° bend with one ram stroke and prevent crushing and kinking of thin-wall material. The attachments bend ¾" - 2" thin-wall conduit . . . easily and quickly applied to the No. 770 or 775 Power Unit.

Nos. 770-BB and 775-BB Hydraulic Bus-Bar Benders. For making accurate bus-bar bends in a wide range of sizes. Consists of the No. 770 or 775 Power Unit fitted with a GREENLEE bus-bar bending attachment. Regular "U" bends, 90° bends, or offsets are easily made in any size bar up to 6" wide and 1" thick.



No. 785-BE Power Bender. A powerful portable bender for heavier bending. Develops 100 tons of ram pressure to bend rigid conduit or standard pipe in 1¼" to 6" diameters, and is rugged enough to bend 5" extra-heavy or double-extra-heavy material with ease. 20" stroke permits 90° bends in one setting. Can be driven by either an electric or gasoline motor.

HAND BENDERS FOR CONDUIT, TUBING



Forming small-radius bends without flattening or kinking is simple work with a GREENLEE Hand Bender. Especially designed to form neat bends for sharp corners, nooks, and other close quarters. Eliminates many manufactured bends and fittings, saves up to 75% in time and material on many jobs.

No. 761 Hand Bender for rigid conduit (I.P.S.). For fast, easy bending of pipe or rigid conduit of any metal in ⅛", ¼", ⅜", and ½" nominal sizes.

No. 764 Hand Bender for thin-wall conduit (E.M.T.). For thin-wall conduit, known as E.M.T. (Electrical Metallic Tubing). Quickly bends conduit of ⅜", ½" and ¾" nominal sizes.

GREENLEE TOOL CO., 1745 COLUMBIA AVE., ROCKFORD, ILLINOIS

11.0 Signal

The program amplifier shall be capable of delivering (30 watts—(up to 60 rooms), 60 watts—(up to 100 rooms) or 100 watts (over 110 rooms) of audio power at less than 1% distortion when operated from a 60-cycle power source at 110 to 120 volts ac. Maximum power consumption shall not exceed (150 watts for 30-watt ampl.; 260 watts for 60-watt ampl.; 300 watts for 100-watt ampl.) at rated power output. An input signal of 2 volts shall be sufficient for driving the amplifier to full output when the input impedance is ½ meg ohm. The amplifier shall provide an output of 25 volts balanced line for speaker and distribution line matching. The output regulation shall be within 2 db from no load to full load—100, 200 and 4000 cycles, and it shall have a frequency response of 50 to 15,000 cps plus or minus 1 db. (ABCD)

4. Intercom-Auxiliary Channel Amplifier

The amplifier shall operate from a 60-cycle 117-volt ac source and shall consume no more than 150 watts at full output. It shall be designed to deliver (10 or 30 watts) when driven by an input signal of 6 mv. Distortion shall be less than 3% at rated output and the unit shall be capable of operating within 3 db over a range of frequencies from 50 to 15,000 cps. The amplifier shall provide for a 25-volt balanced line and center tap at the output. (CD)

5. Room Selector Switchbanks

Selector switches shall be supplied for —— rooms (insert required number). There shall be (10 or 20) switches to a panel and these switchpanels shall be designed to mount on the sloping front plane of the console cabinet. The unused panel space shall be filled with blank panels. Each panel shall be finished in grey metalustre. Each room selector switch shall be of double-pole, lever action type. It shall have four positions clearly marked "A", "B", "OFF", "COMM". The panel shall be equipped with an $\frac{11}{32}$ in. wide metal channel which shall accommodate room identification strips. Each switch shall be supplied with a telephone type screw-on knob. Possibility of cross-talk between channels shall be minimized. Separate lug connectors shall be available for each room pair in addition to an appropriate number of lugs for shields.

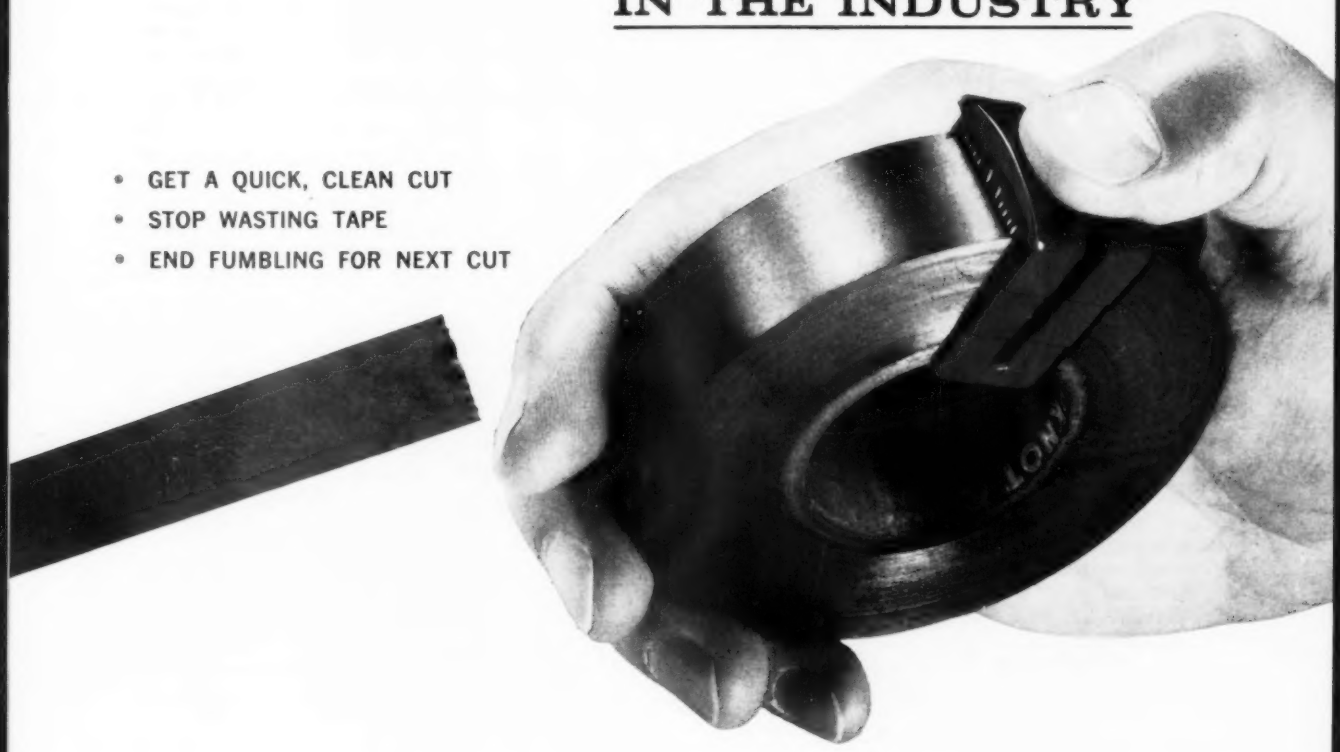
If room annunciation is desired, add the following:

(*Continued on page* 236)

FREE!

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*pat. pending

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Makers of SLIPKNOT FRICTION TAPE

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Easiest route to a *successful* wiring installation is through a Heinemann indoor service entrance unit.

Easiest, because Heinemann equipment is built with the installation in mind. Boxes are quickly mounted . . . there are plenty of knockouts . . . and ample room in which to spin a screwdriver without skinning knuckles. Yet the unit is compact, occupying less than *half* the space required by comparably rated fused safety switches . . . and costs little more.

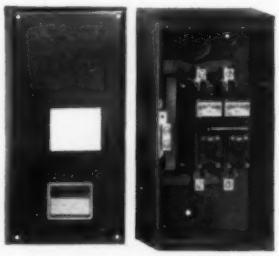
Successful, because the Heinemann circuit breakers inside employ the most dependable type of operation ever devised . . . hydraulic-magnetic actuation. Heat never affects the rating of the Heinemann magnetic sensing coil . . . you can locate the breakers next to steam pipes if you have to. Hydraulically-controlled time delay prevents nuisance tripping.

Heinemann's simple two-position handle means the breaker is always clearly ON or OFF, *never* at a confusing intermediate position.

It all adds up. To fast, easy installations. *To satisfied customers.*

Heinemann Series XH9000
Indoor Service Equipment

- For main service entrance or motor or power circuits.
- Holds one two-pole Companion Trip® breaker, 50 to 100 amps.
- Has 8 knockouts.
- Flush or surface mounting.
- Measures 13¼" H., 6¹¹⁄₁₆" W., 3¾" D.
- Heavy-gauge steel, grey baked-on enamel.
- Listed by Underwriters Labs, Inc.



Want more information? It's available in Bulletin 1000, a handy 24-page, illustrated catalog of the entire Heinemann enclosed equipment line.

HEINEMANN ELECTRIC COMPANY

132 Plum Street Trenton 2, N. J.

S-A. 1728-A

11.0 Signal

(a) Annunciator shall have its indicators positioned directly adjacent to each room selector switch. A room calling the console shall activate a buzzer at the console and shall cause the annunciator to indicate the room. (ABCD)

6. Radio Tuner

The radio tuner shall be superheterodyne receiver capable of program reception from FM stations over a frequency range of 88 to 108 mcs and AM stations over a frequency range of 530 to 1650 kcs. It shall be designed to operate from a 117-volt, 60-cycle source. Power consumption shall not exceed 60 watts. There shall be a visual tuning meter on the front panel for determination of exact station position. The unit shall incorporate FM antenna inputs of 75 or 300 ohms for use with an external FM antenna. A minimum of 11 tubes shall be provided. The FM section of the tuner shall contain two stages of I. F. amplification and two stages of limiting. Band width shall be 180 kcs. The tuner shall include an AFC circuit to prevent drift and it shall contain provision for defeating the AFC. FM frequency response shall be from 50 to 15,000 cps plus or minus 1½ db, and 2.5 microvolts shall provide 30 db quieting at 75 ohms input. An automatic volume control circuit on both the AM and FM channels shall insure selectivity under strong signal conditions.

The AM section shall contain two stages of I.F. amplification and the band width shall be 10 kc. Frequency response shall be from 30 to 7000 cps. At 1-volt output, distortion shall not exceed .8% and 5 microvolts shall provide 0.5 v output. The tuner shall be finished in grey metalustre and attractively screened to indicate station settings and controls. Oscillator shielding shall conform to FCC specifications for minimum radiation. (ABCD)

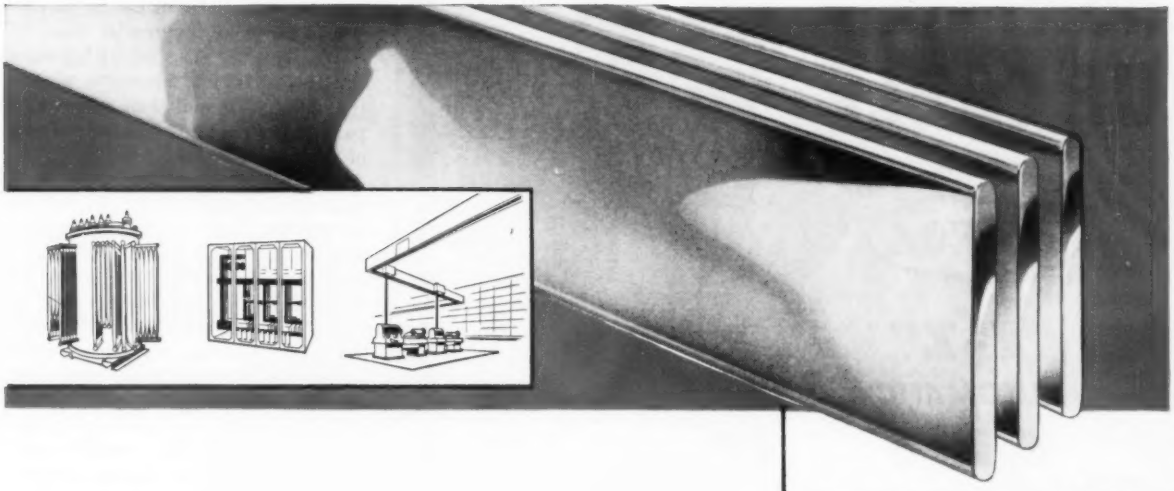
7. Record Player

Note: Select (a) or (b)

(a) The record player shall be of the automatic type capable of handling a 1-in. stack of 7-in., 10-in. or 12-in. diameter records, and shall be capable of playing at all four standard speeds of 16, 33⅓, 45 and 78 rpm. The mechanism shall be designed to automatically shut-off after the last record has been played. The unit shall incorporate a switch which shall enable the operator to manually place the tone arm on the record if desired.

(*Continued on page* 238)

Another New Product for The Electrical Industry from Reynolds



SILVER PLATED aluminum BUS BAR

Reynolds new Silver Plated Bus Bar offers substantial economies over unplated copper bar . . . from 35 to 50% lower in price. It should be of prime interest to manufacturers of metal enclosed switchgear, power transformers, bus duct, panel boards and other electrical equipment, and to electrical contractors for the following reasons:

It is attractive in appearance, light in weight and represents a sizeable savings over commonly used bare or plated copper conductors.

Bolted joints can be made with no prior preparation of surface and no joint compound.

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For more information or assistance from Reynolds Engineering Service, call your nearest Reynolds office or write Reynolds Metals Company, P. O. Box 1800-ET, Louisville 1, Kentucky.

The Finest Products Made with Aluminum are made with REYNOLDS ALUMINUM



NOW! STRIP UF CABLE with IDEAL "E-Z" AUTOMATIC WIRE STRIPPERS

. . . as easy to use as your pliers!

With the "E-Z" it's easy to strip the outer sheath and web, then the inner conductors (2 or 3 wire 12 or 14 ga.) from non-metallic sheathed cable — without cutting, nicking or other damage to the wire ends. The "E-Z" Automatic is lightweight yet durable all-steel construction for long, heavy duty service life. Available in 5 other models for stripping various types of wire from 8 through 26 ga.



1. Clamps wire



2. Cuts insulation



3. Strips it off



4. Lever automatically stops return of arms until wire is removed.

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IDEAL DELUXE CABLE RIPPERS



A practically designed mechanic's tool for quickly and easily ripping the outer sheath from non-metallic covered cable up to ½" O.D. Faster—just insert the cable, set blade depth and rip away. Rigid frame and cradle assure straight cut. Replaceable steel blade; durable aluminum rip-grip for speed and safety.

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IDEAL

11.0 Signal

The unit shall be effectively noise free and shall incorporate a high quality ceramic cartridge with sapphire tipped stylii capable of passing signals over a range of frequencies from 30 to 15,000 cps. The record changer shall incorporate a removable plug-in type head. The unit shall mount in a pull-out drawer located in the pedestal of the console.

(b) The record player shall be a manually operated equipment capable of handling records with diameters from 7 ins. to 16 ins. at any one of the four standard turntable speeds of 16⅔, 33⅓, 45 and 78 rpm and at variable speeds from 16 to 20 rpm and 29 to 86 rpm. An adapter shall be furnished for operation at speeds of 45 rpm, and a strobe disc shall be provided for speed testing. The unit shall contain a shaded 4-pole constant speed motor which shall be capable of driving a statically and dynamically balanced 3⅜-lb heavy gauge turnable. The unit shall be equipped with a heavy rubber mat, and shall incorporate a removable plug-in type head. Speed variation shall be less than 1% and flutter index shall be less than 0.5%. Power requirements shall not exceed 15 watts, and rumble shall be −40 db. The unit shall be mounted in a pull-out drawer located in the pedestal of the console.

8. Privacy

It shall be possible to incorporate a complete privacy feature into the school console system without any additional wiring. The privacy unit shall prevent the console operator from monitoring any room without consent of the room's occupant, but shall not interfere with the transmission and quality of program material, voice, or time signals from the console.

The unit shall incorporate facilities for generating an intermittent signal in any classroom when the console function selector lever is in the listen position and switch for the classroom at the console is in the COM position.

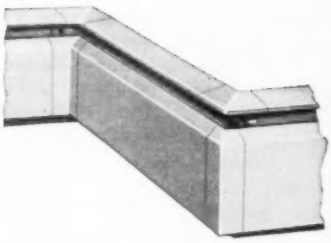
9. Priority Control

It shall be possible, through the use of the room speaker switches of the console, to transmit regular programs from the console to the remote system speakers. (Auditorium-Gymnasium, etc). In ALL-CALL and EMERGENCY broadcasts from the console, the relay shall automatically transfer the remote system speakers from the remote amplifier output to a speaker line from the console. Pro-

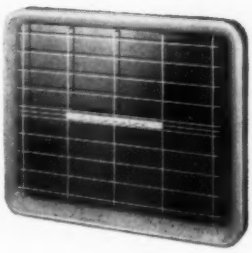
(*Continued on page* 240)

ELECTRIC HEAT...

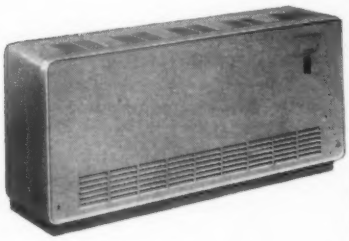
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You'll like the Chromalox line, too — renowned for quality the world over, yet it costs no more. With quality, there's customer satisfaction, without call-back for you. Long life, fast installation, attractive appearance — are all in your favor with Chromalox.

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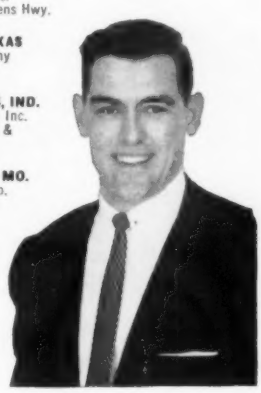
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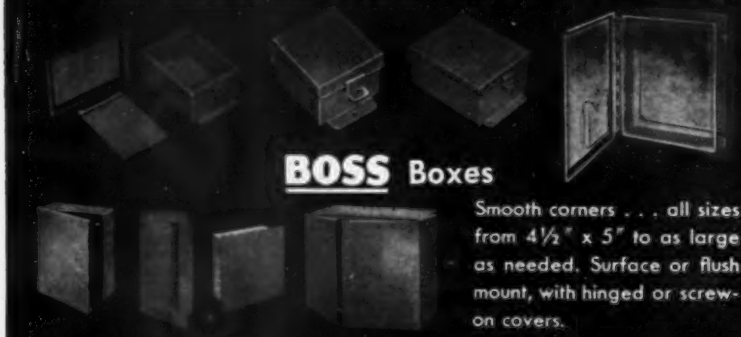
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Be sure of QUALITY, positive of excellent SERVICE on stock or "specials", with the complete line of BOSS Boxes, Wireway & Fittings. UL approved.

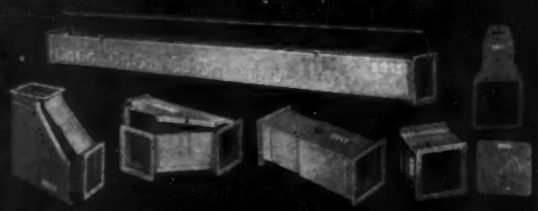
BOSS Flangeless Hinged Cover Lay-in



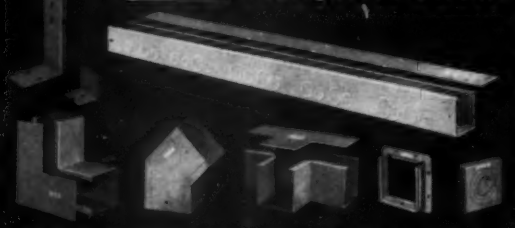
Assemble and lay in wire after wireway is installed—no wire pulling or risk of damaging insulation!

BOSS Flanged Hinged Cover

Flanged on both ends . . . any number of sections can be put together. Knockouts on sides and back.



BOSS Flangeless Screw Cover



Equipped with protective screw shields. Cover has keyholes for easy removal without entirely removing screws.

Sold thru leading distributors. Write for new complete line Catalog.

THE HUENEFELD CO.

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11.0 Signal

vision shall be made for visual indication at the console when the remote system is "off" or "on".

10. Remote Control

The unit shall provide remote control of the volumes of two microphone channels. These controls shall be mounted on a 2-gang plate designed to mount on a 2-gang plaster ring located as shown on the plans.

11. Emergency Signalling

The console shall include the necessary equipment required so that EMERGENCY - DISASTER telephones located at strategic points in the school may be capable of broadcasting EMERGENCY announcements over the sound system without the use of manual controls either at the console or at remote locations. The telephones shall, when the handset is lifted from the cradle, automatically turn the system "on", if "off", indicate by means of a pilot jewel light when the system is ready for operation, preset the volume level, permit distribution of an emergency announcement to all speakers in the system, and provide an audible side tone in the handset to indicate that the message is being transmitted.

(a) It shall also be possible to distribute a siren signal rising from 610 to 1040 cps in 5 seconds and declining to 610 cps in 7 seconds for Air Raid or Fire Alarm signals.

12. Time Signals

Note: select (a) or (b).

(a) The console shall incorporate the necessary circuitry so that a constant tone signal may be broadcast to all speaker stations simultaneously when activated by a pulse from an external program instrument.

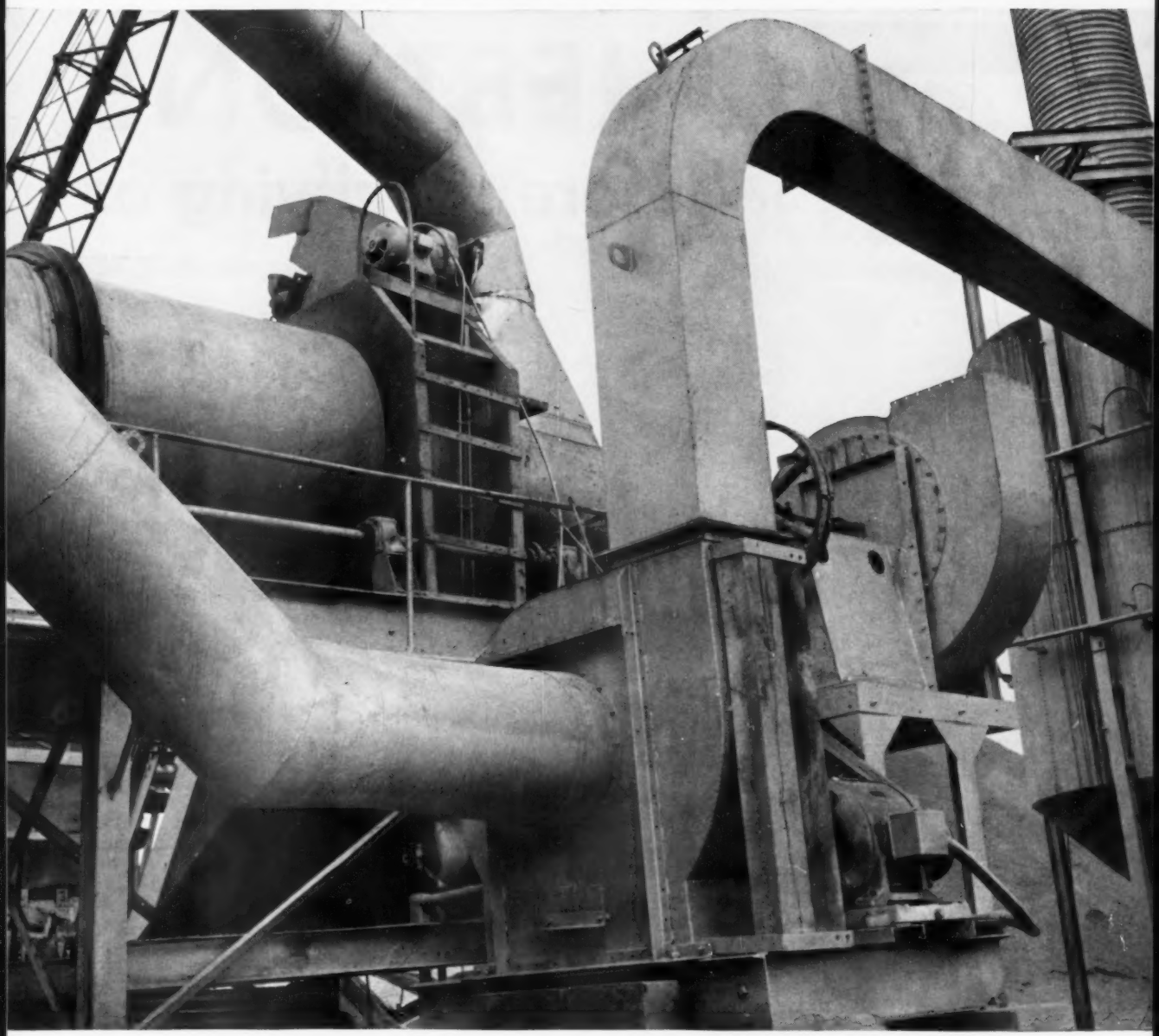
(b) The console shall incorporate the necessary circuitry so that a constant tone signal may be broadcast to speaker stations connected to any one of two, four or six program schedules, determined by the size of program instrument installed and cross connect panels. The cross connect panels shall be installed in the console. This feature shall be accomplished with or without individual room speaker relays.

B. Loudspeakers

1. At each location where shown on the plans install a (surface-mounted; flush mounted) loudspeaker assembly consisting of an 8-in. PM speaker having a magnet weighing 2.15-oz, and constructed of Alnico V. Each speaker shall incorporate a line match-

(*Continued on page* 244)

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Out in the weather or inside the plant . . . use Century Motors

Century electric motors are engineered to handle the roughest, toughest kind of industrial service. Industry specifies Century motors—from 400 HP to 1/20 HP—for long-hour duty on exacting jobs.

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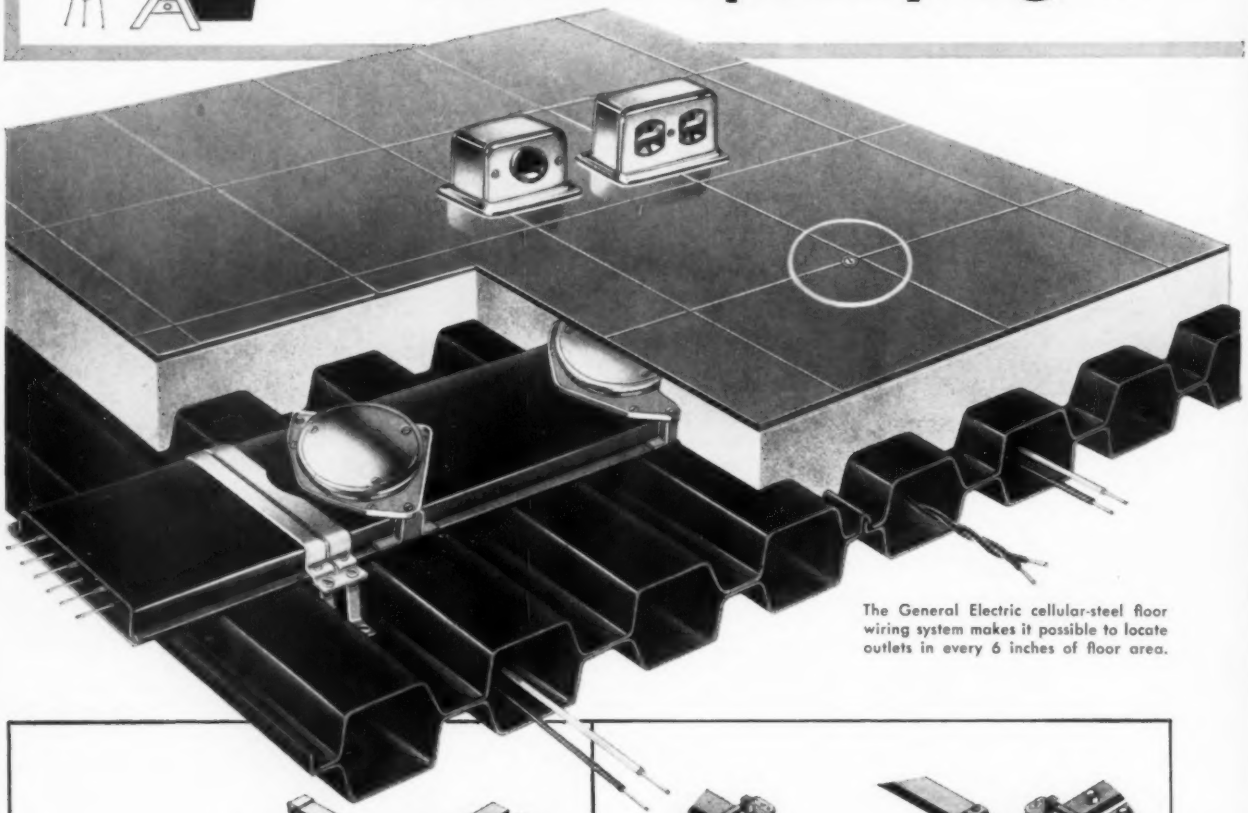
Your best motor investment is Century. Century's complete line enables you to select the right motors for the work you have to do. Call your local Century man or Authorized Century Distributor. Find out how Century motors will meet your needs.

Century MOTORS

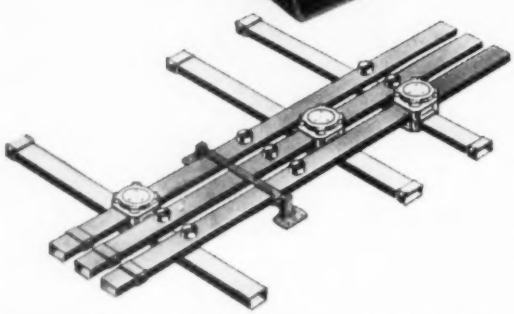
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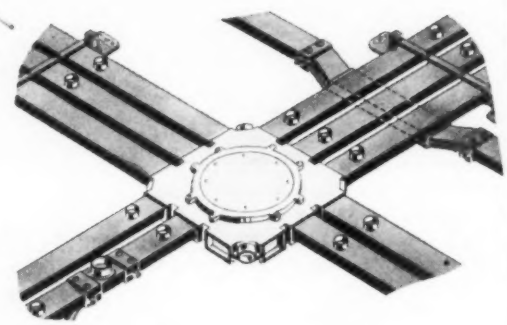
7 QUESTIONS before specifying or



The General Electric cellular-steel floor wiring system makes it possible to locate outlets in every 6 inches of floor area.



General Electric two-level steel underfloor wiring solves difficult feeding problems and allows complete separation of services.



For standard underfloor layouts in fills as shallow as 2½ inches, use the General Electric single-level steel duct system.

Progress Is Our Most Important Product

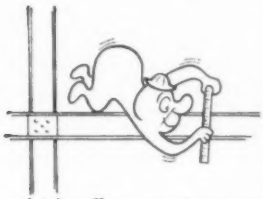
GENERAL ELECTRIC

TO CONSIDER
purchasing underfloor wiring



1. DOES THE SYSTEM MEET BOTH STRUCTURAL AND ELECTRICAL REQUIREMENTS?

Practically any combination of structural and electrical specifications can be met by General Electric's range of 3 underfloor wiring systems. For standard layouts in fill and slab or monolithic floors, for example, the G-E single-level steel system is ideal. General Electric's two-level system offers greatly increased feeding capacity and *complete* separation of services. For cellular-steel floor construction, G-E cellular-steel floor wiring makes it possible to locate outlets in every 6 inches of floor area. All 3 systems provide excellent grounding facilities.



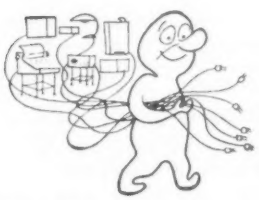
2. WILL THE SYSTEM FIT THE FLOOR FILL?

Fill as shallow as 2½ inches can be used with the General Electric single-level system. The G-E two-level system, which offers greater capacity and flexibility, can be accommodated in a minimum fill of 3½ inches. General Electric's header duct for wiring cellular-steel floors now offers 41% additional capacity yet fits in the normal 2½ inches of concrete.



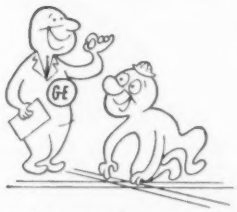
3. IS THE SYSTEM EASY TO INSTALL?

Even inexperienced crews find General Electric systems easy to install, because they are straightforward in design and accurately made to close tolerances. The component parts fit together without difficulty—save time on the job.



4. WILL THE SYSTEM HANDLE THE NUMBER OF SERVICES ANTICIPATED?

Any number of services can be handled by the General Electric cellular-steel floor wiring system or by the G-E two-level underfloor distribution system. Both feature complete separation of services, with each service occupying a separate junction unit. For standard layouts with up to three services, use the G-E single-level duct system.



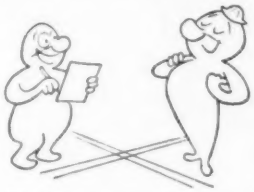
5. IS THE MANUFACTURER PREPARED TO GIVE ASSISTANCE?

General Electric's underfloor field representatives help you plan your system if desired, and stay with every job until they are sure installation is satisfactorily under way. G-E representatives are ready to put years of experience to work for you the moment you need it.



6. ARE ALL NECESSARY COMPONENTS AVAILABLE FROM THE MANUFACTURER?

A full line of components is available from General Electric. With 29 years experience in underfloor wiring, G.E. has anticipated nearly every installation requirement and can provide the components needed to do the job.



7. DOES THE SYSTEM MEET ACCEPTED CODES AND STANDARDS?

Underwriters' Laboratories, Inc., lists all three General Electric systems. They also meet Federal Specifications.

Send your own questions to General Electric, or send the coupon for data and installation manuals on G.E.'s three underfloor systems.

To General Electric Company
Conduit Products Department, Section C82-518
Bridgeport 2, Connecticut

Please send Bulletin on

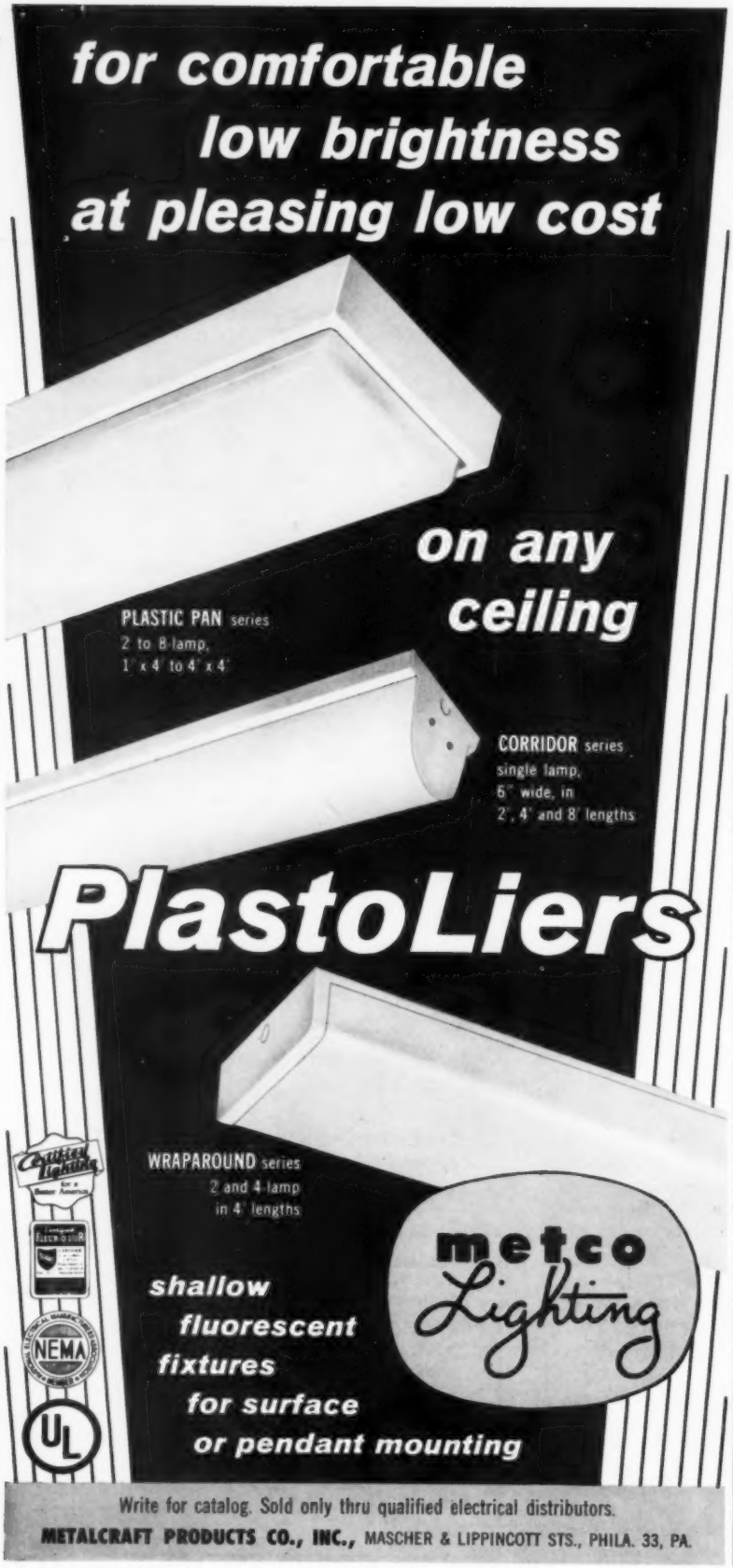
- ☐ G-E steel underfloor wiring systems
- ☐ G-E cellular-steel floor wiring system
- ☐ Enclosed is a description of my underfloor wiring problem. What do you suggest?

Name_____

Title_____

Company_____

Address_____



11.0 Signal

ing transformer, and shall be housed in an attractive (surface type or flush box with matching grille to blend with the decor). The overall frequency response shall be from 60 to 10,000 cps and the assembly shall be capable of handling 10 watts of power. The line matching transformer shall be tapped at ½, 1 and 2 watts.

2. Loudspeakers, (Corridor Type)

At each location where shown on the plans, install a similar loudspeaker as shown above, but install in a 2-way housing, constructed of metal. The baffle shall be adequately treated inside to prevent metallic resonance.

3. Loudspeakers, (Auditorium Type)

At each location where shown on the plans install a 12-in. loudspeaker having the following minimum specifications.

The unit shall be capable of handling 25 watts of continuous power and shall have a frequency response of from 45 to 15,000 cps. It shall include a built in LC type dividing network. The woofer portion of the speaker shall handle frequencies up to 2000 cps, while the tweeter portion shall handle frequencies over 2000 cps. The magnet of the loudspeaker shall be constructed of Alnico V, and the unit shall be provided with a constant voltage transformer having taps at 2, 4, 8, and 16 watts. The speaker assembly shall be properly housed in a wooden cabinet (either recessed behind a decorative grille or mounted on the surface of the wall).

4. Loudspeakers, (Weatherproof Type)

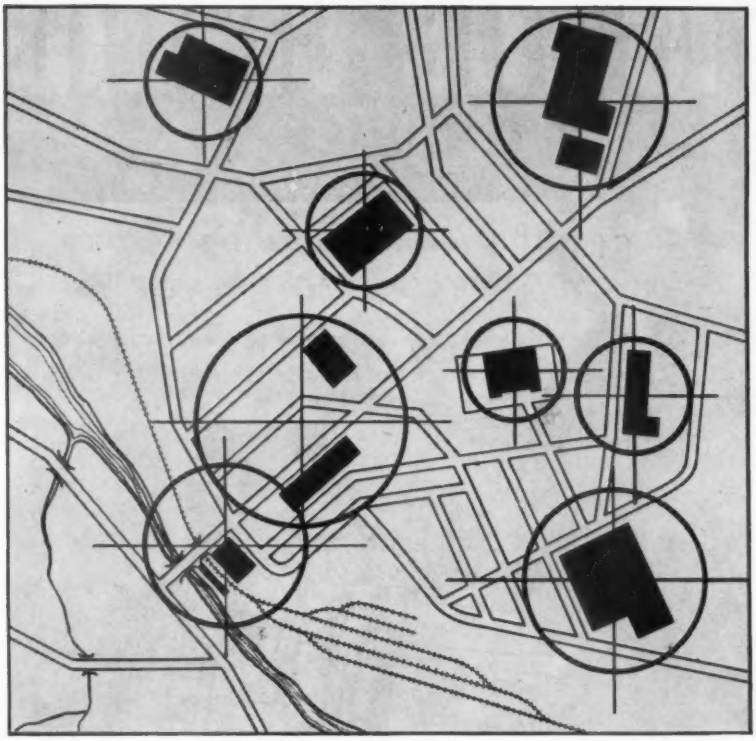
At each location where indicated on the plans, install a loudspeaker (weatherproof, if located outside of the building) of the re-entrant type constructed of metal and capable of handling 12 watts of continuous power, and having a frequency range of from 300 to 10,000 cps.

C. Microphones

1. Locate at the central control console a special dynamic microphone assembly consisting of a weighted base—incorporating a momentary DPDT spring return switch with self wiping silver plated contact—to which shall be attached a 12¾ length of chrome finished flexible gooseneck section. At the top of the latter shall be firmly and attractively attached a sensitive, rugged, microphone which shall provide a frequency response of 50 to 7500 cps. The output level shall be −56 db. The base shall be fitted with

(*Continued on page* 248)

EXIDE DECLARES WAR



The target area. Look for the enemy in every store, school, office building, factory, restaurant, hospital, institution, theater, or other building where people congregate. There are hundreds of them in your locality.

Launches all-out attack on sudden darkness in 1958. Thousands of victims need Exide Lightguard*

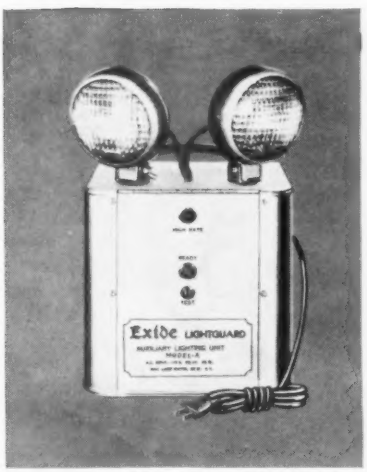
1958 will witness a full-scale, concentrated Exide advertising campaign aimed at bringing relief to the big majority of your customers who still suffer from the risk of sudden darkness.

It will have two primary goals

1. **Alerting them to the danger of sudden darkness so it will be easy for you to sell them Exide Lightguard.**
2. **Sending them out to look for the dealer who has Exide Lightguard in stock for immediate delivery.**

This campaign is being waged to help you. Make sure you are ready to benefit from it. Sell Exide Lightguard to the hundreds of customers in your area who desperately need protection from sudden darkness. Stock up now. For complete details, send coupon.

*Lightguard is an Exide trademark, Reg. U.S. Pat. Off.



The weapon. Exide Lightguard Emergency Lighting Units. They kill sudden darkness instantly, automatically. Portable. Easy to set up. Most of your customers will want several. Distribute freely. Exide can supply all you need.



Infiltration tactics. During the year 1958 Exide will slip over 5 million advertising messages right past the most alert secretaries to help make your selling job easier. Doors will be opened to you . . . many customers pre-sold.

Exide INDUSTRIAL DIVISION
The Electric Storage Battery Company, Phila. 2, Pa.

How can I become a dealer for Exide Lightguard?

Name _____

Company _____

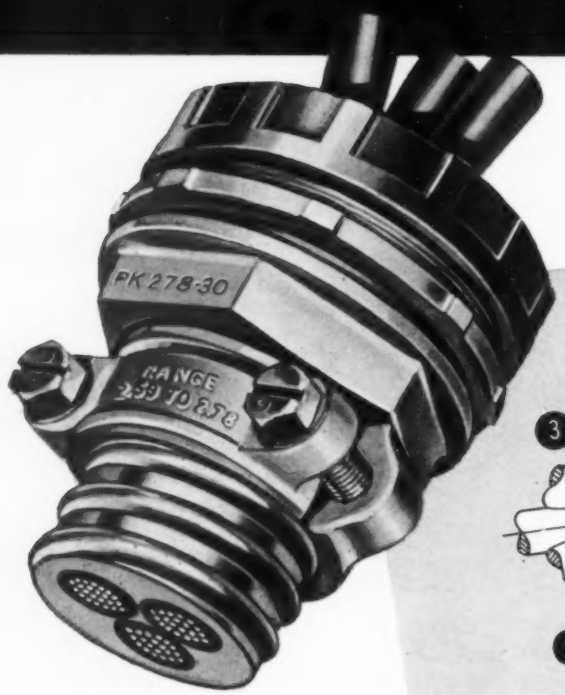
Street _____

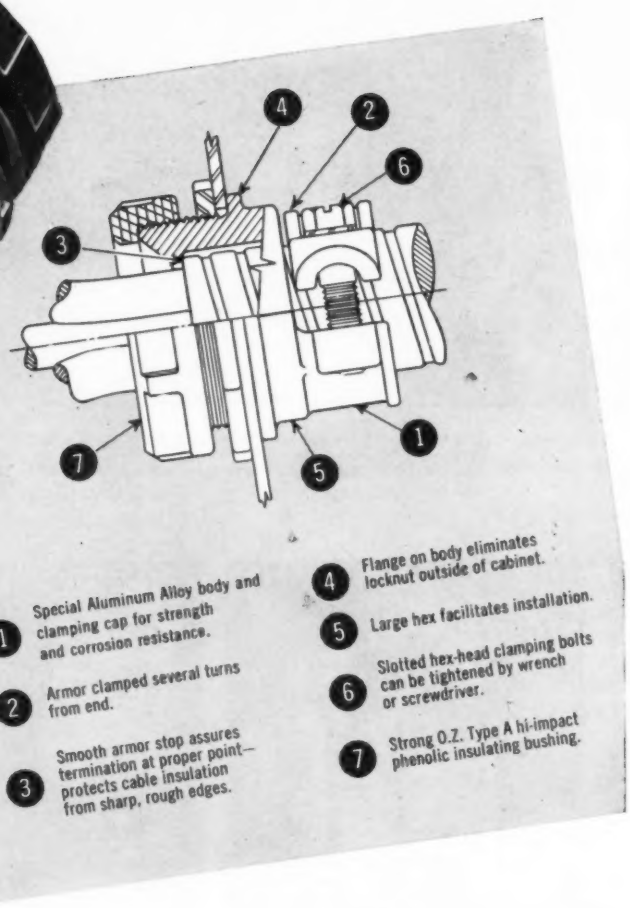
City _____ Zone _____ State _____

16

from every angle–

O.Z. TYPE "PK" is the clamp





1. Special Aluminum Alloy body and clamping cap for strength and corrosion resistance.
2. Armor clamped several turns from end.
3. Smooth armor stop assures termination at proper point—protects cable insulation from sharp, rough edges.
4. Flange on body eliminates locknut outside of cabinet.
5. Large hex facilitates installation.
6. Slotted hex-head clamping bolts can be tightened by wrench or screwdriver.
7. Strong O.Z. Type A hi-impact phenolic insulating bushing.

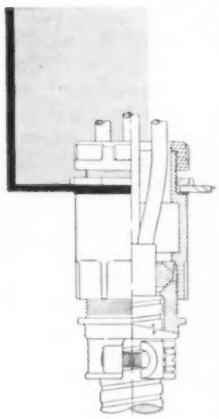
Here is a clamp designed specifically to meet the requirements of interlocked armor cable applications. The O. Z. Type "PK" Clamp provides exceptional speed and ease of installation, whether your cable enters the cabinet from the top, bottom or side. It is available for interlocked armor cable ranging in size from .45″ to 4.28″ O. D.



for ARMORED CABLE

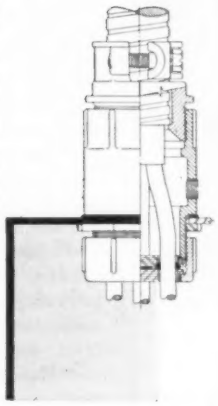
combines with standard O.Z. fittings for any terminating or splicing job involving INTERLOCKED ARMOR CABLE.

Seals cable ends to protect insulation against moisture and other contaminators—can also be used with threaded hubs and bosses to provide watertight cable entrances.



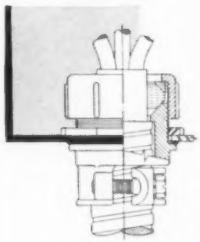
TYPE "PKC"

Compound type terminator for interlocked armor cable entering bottom of cabinet.



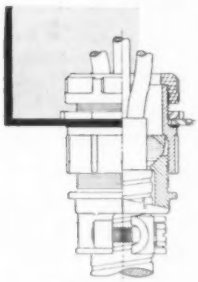
TYPE "PKT"

Compound type terminator for interlocked armor cable entering top of cabinet.



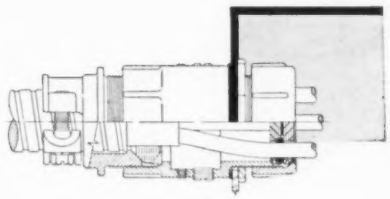
TYPE "PKG"

Sealing gland type terminator for interlocked armor cable entering a cabinet.



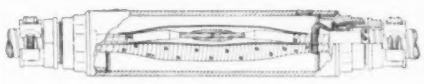
TYPE "PKS"

Provides watertight cable entrance seal in any position. Can also be used as a compound fitting in upright position.



TYPE "PKH"

Compound type terminator for interlocked armor cable entering side of cabinet.



TYPE "PKJ"

Splicing fitting for interlocked armor cable.

For complete information on these and other O. Z. Fittings for use with Interlocked Armor Cable, write for Engineering Bulletin 135A.

O.Z. ELECTRICAL MANUFACTURING CO., INC.

262 BOND STREET • BROOKLYN 17, N. Y.

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- CONDUIT FITTINGS
- INTERLOCKED ARMOR CABLE FITTINGS

NEW

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Intermatic®

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RUGGED, heavy-duty
"T-RATED"
TIME SWITCHES

TUNGSTEN RATED to carry incandescent lighting loads with an inrush surge of more than *8 times* their normal amperage rating!



A. NEW ALLOY-T CONTACTS — An amazing new composition that resists pitting, arcing and sticking. With increased contact surface and self-cleaning design you get positive contact, better conductivity and freedom from welding.

B. NEW U-BEAM BLADES — Spring brass and channeled for greater rigidity . . . eliminate blade bounce, give more positive make and break action.

C. NEW HI-POWER, SWITCHING MECHANISM—gives **four times more** switching power, and positive action, time after time. . .



A TIME SWITCH FOR EVERY TIMING NEED

Series T100: For standard ON-OFF operations—1 to 12 on-off operations a day . . . timings from 1 to 23 hours . . . heavy duty . . . rated 35 amperes.

Series T170: For skipping operation on selected days—"Skipper"—Skips operation automatically on weekends, holidays or any selected days . . . 1 to 12 on-off operations a day . . . timings from 1 to 23 hours. . . . rated 35 amperes.

Series T180: For ON-OFF cycles from 5 to 60 minutes—Up to 14 on-off cycles a day . . . each cycle independently adjustable from 5 to 60 minutes . . . 35 amperes.

Series T960: For poultry feeders, process timings, fans, oil well pumping—For 1-96 on-off operations every 24 hours.

Cycler-12: For 1-12 ON-OFF operations within 12 minutes—for fans, poultry foggers, pumps, process timings.

Series P370: For automatic control of room air conditioners . . . portable, plug-in . . . for air conditioners up to and including 1 horsepower. For 2 or 3 wire units.

Series V21000: For 7-day operation—preset ON-OFF operation at various times over 7 days—skips if desired.

Series V22000: For two circuit control—enables switching of two load circuits at different times.

Series V27000: For precision short interval switching—intermittent 24-hour control of recorded music, etc., with switchings at 5 or 15 minute intervals.

Series V28000 & V29000: For bells, signal lights, buzzers, etc.—1 to 288 daily operations.

For Poultry House Lighting. Standard single pole model for morning or all night lighting . . . dimmer switch model for morning and evening or evening only lighting.

Raintight Case—most models available with the only UL approved raintight case for outdoor installations.

Intermatic® TIME CONTROLS

WRITE FOR CATALOG 58-Bt on complete line

YOU CAN *Depend* ON INTERMATIC

INTERNATIONAL REGISTER CO.
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Chicago 12, Illinois

11.0 Signal

a locking type receptacle to accept a locking type microphone cable connecter.

2. Locate in the (Auditorium, Gymnasium, etc.) a high quality (Cardioid or Dynamic) microphone capable of providing for a frequency response of from 50 to 15,000 cps. The output level shall be −87.9 db, and the unit shall be designed for (unidirectional-omnidirectional) pickup pattern. It shall be mounted on an attractive adjustable floor stand which may be adjusted from 24 ins. to 64 ins. in height. The stand shall be finished in chrome with a grey crinkle base.

D. Independent Systems

The amplifier shall be installed where shown on plans on a special wall bracket, which shall permit the amplifier to be lowered from the wall to an angle of 45 degrees for the purpose of turning the equipment on and off and for presetting of volume and tone controls. The unit shall be supplied with a control guard locking plate which shall secure the amplifier to the bracket and protect the controls from unauthorized tampering.

The amplifier shall be capable of delivering 60 watts of audio power at not more than 2% distortion at 100, 400 and 5000 cycles. The frequency response shall be plus or minus 1.5 db from 20 to 20,000 cps. The output regulation shall be within 2 db from no load to full load at 100, 400 and 5000 volts. The amplifier shall provide input facilities for four (50, 200 ohms, high impedance). One mic channel shall provide the facility of switching to accept a signal from a radio tuner, crystal cartridge or low level magnetic phonograph pickup cartridge source. The magnetic input shall provide RIAA playback equalization and produce rated power with an input signal of not greater than 10 mv at 1000 cycles. Each input shall be provided with a volume control and separated preamplifier incorporated in the amplifier, and the unit shall provide for bass control of plus or minus 14 db at 60 cycles and treble control of plus or minus 12 db. All inputs for microphones, etc. shall be provided with special lock type positive polarity receptacles. The amplifier shall have output impedance taps of 4, 8 and 16 ohms as well as taps at 70 volts and 25 volts, and ac receptacle shall be provided at the rear of the unit for powering associated equipment. Provisions shall be made

(*Continued on page* 252)

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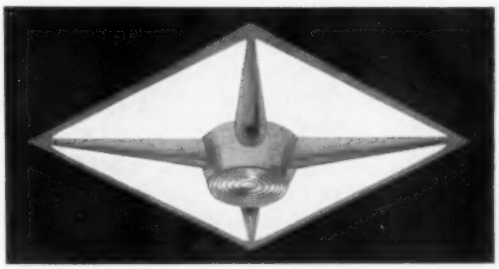
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Here are the reasons why . . .

Sylvania Fluorescents give your customers more light—

at lower cost than all other brands!

Superior engineering makes Sylvania fluorescent lamps better in many important ways . . . makes every lamp a better tool of production and sales to increase your customers' profits.

TODAY, good lighting is more than illumination . . . it is a basic tool of production and sales. Sylvania, with this important premise always at work, offers your customers a complete line of modern fluorescent lamps that assures efficient lighting . . . provides performance that means maximum service from their present fluorescent lighting system, and a higher return on their investment in the illumination of offices, factories or stores.

Why Sylvania lamps are best

It takes many things to make better fluorescent lamps. That's why ordinary fluorescents cannot match Sylvania lamps for light output, lamp life and dollar-for-dollar lighting value.

The reason? Sylvania builds many important major features into fluorescents.

Check these many points of superiority. See for yourself why your customers get more and save more . . . why you make more. Notice, too, that Sylvania makes its most important comparisons with other brands . . . not with Sylvania products of the past.

Sylvania fluorescent lamps are as much as 14% brighter

Tests in the laboratory and working installations demonstrate that Sylvania lamps consistently deliver more light.

Equally important, during the past two years, an actual comparison of Sylvania fluorescent lamp performance with that of other brands shows Sylvania to deliver up to as much as 14% more light, depending on the lamp type.

Thus, you get the maximum light you expect . . . all the light you pay for . . . from the start.

Sylvania's greater maintained brightness means 7 lamps free for every hundred you use

Sylvania fluorescents maintain their greater brightness throughout useful life. For example, at 3,000 hours, in a single-shift operation, 100 Sylvania lamps deliver the light output of about 107 ordinary fluorescents. In effect, you get a dividend of light equal to 7 free lamps . . . more light-per-lamp from the power you pay for.

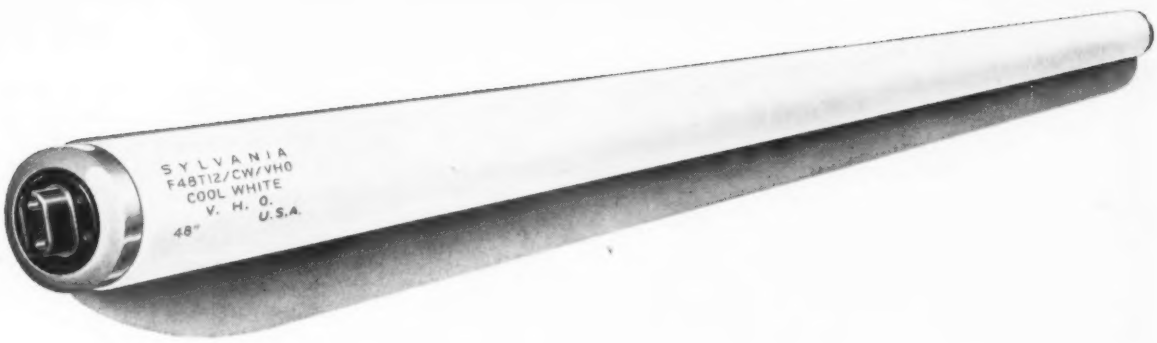
Sylvania welds all bases . . . eliminates faulty lamp contact

Sylvania welds the tube-to-base contact points in all its fluorescent lamps. Other brands use soldered contacts.

By welding, Sylvania completely eliminates the corrosion caused by soldering. Faulty lamp contact so common with ordinary fluorescents is eliminated. As a result, Sylvania fluorescents burn brighter far longer . . . save dollars and time in lamp maintenance.

Only Sylvania's exclusive coating process homogenizes phosphors for maximum brightness

Year after year, Sylvania lamps have delivered more light for a far longer time than ordinary fluorescents because of superior phosphors. In fact, only now are some other brands being introduced with phosphors of a quality which Sylvania has long since improved.



In addition, Sylvania uses an exclusive coating process which more uniformly distributes these superior phosphors throughout the tube. This unsurpassed uniformity is made possible by homogenizing the phosphors—and, in itself, contributes a minimum of 3% greater brightness over other processes now in use.

Sylvania lamps are 99.9% free of performance defects

Every lamp that leaves the plant is subjected to the infallible scrutiny of electronic devices that test and inspect for every possible flaw. One unit, for example, is so critical it can detect, in a fraction of a second, a lamp leak that would otherwise not become apparent until after many months of use. In this way you are assured of the highest lamp quality and performance.

Revolutionary VHO—first lamp to give 250% as much light as a standard tube

The Sylvania VHO (Very High Output) lamp represents a major breakthrough in fluorescent lighting. It produces 2½ times the light output without changing the size or shape of the tube.

The high intensity lighting "punch" of Sylvania's VHO offers new lighting levels that make it practical for the first time to gain the advantages of fluorescent lighting for High Bay installations, and for Outdoor illumination.

VHO lamps cost less to buy—less to use, and maintain greater brightness throughout life than other types of very high intensity fluorescents.

These facts are presented in the interest of demonstrating how better lighting is possible at a lower cost . . . how it contributes to increased production and working efficiency, and supports the many factors that reduce operating costs to improve your customers' profits.

We believe this concrete evidence of Sylvania's superiority in fluorescent lighting will earn the serious consideration of every executive or purchasing authority you sell . . . and add immeasurably to your volume and profit.

Promote the Sylvania line—take advantage of the extra sales edge it offers. And for any assistance or literature, call your local Sylvania Representative or write us today.

Signed, Frank J. Healy

F. J. HEALY, President

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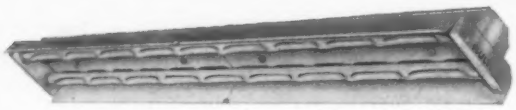
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All standard shapes in porcelain enameled finish 100 watt to 1500 watt sizes.



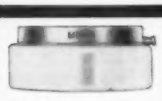
HIGH BAY REFLECTORS
For mercury or incandescent. Alzak Aluminum porcelain on steel.



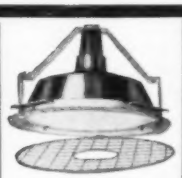
VAPOR PROOF FIXTURES
Cast aluminum holders porcelain reflectors 100 w. to 500 watts.



RLM 2 lite 40 w. INDUSTRIAL FIXTURE for preheat rapid start lamps. Porcelain enameled reflector with apertures for upward lighting. Adaptable for continuous row mounting.



CEILING MOUNT TYPE FIXTURE
with or without hinged opal Globe Aluminum Holders. 8" to 16" Diam Globes



Gymnasium Fixture
for suspended ceiling 500 watt porcelain enameled reflector



ILE-LITE
For library stacks & stock rooms. Porcelain enameled



Fluorescent strip with or without porcelain symmetric or asymmetric reflector

MULTI

ELECTRIC MFG. INC.

4237 W. LAKE ST. CHICAGO 24



PARKING AREA POST LIGHTS



FLOODLIGHTS

11.0 Signal

for controlling the volume of all four inputs from a remote point by means of a four channel remote controller. The unit shall be finished in grey metalustre.

All wiring shall be No. 20 AWG, twisted stranded cable covered by an overall plastic jacket. All speaker cable shall be covered by an overall braided shield, with an overall plastic jacket.

Low level and high level lines shall be installed in separate conduits, and shall under no conditions be run in the same conduit.

11.4 Paging Systems

A. Lamp annunciator, three call.
B. Central code transmitter.
C. Voice, multiple circuit.

11.41 General

Furnish and install a (trade name and/or number) paging system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications, and left in first-class operating condition.

11.42 Operation

A. Lamp annunciator: In corridors at intersections and nurses' stations, doctors' lounge, library, auditorium, nurses' dining room and at other locations shown on plans, there shall be a paging lamp annunciator. There shall also be enclosed therein a buzzer (or chime may be mounted adjacent to annunciator) with externally controlled cutoff switch. Adjacent to telephone switchboard operator there shall be a portable keyboard with three rows of keys for paging three persons, and provided with flexible cable with multiplug and receptacle to a flush terminal cabinet mounted in wall. Operation of the buttons in the same row will light and flash correspondingly numbered simultaneously in all lamp annunciators and pilot lights on the keyboard. When more than one person is to be paged, additional rows of buttons are operated and coded lamp signals appear in sequence and flash. System shall have a capacity of 120 calls using 3-2 digit code numbers or 210 calls, using 4-digit codes. Additional buttons shall be included to connect or disconnect the system and to operate the audible signals to obtain special attention. A control cabinet shall

(*Continued on page 254*)



New Honeywell W237 Fire Alarm Panel

Honeywell systems plus Honeywell support add up to new profits for electrical contractors!

LATEST addition to Honeywell's new line of electrical systems is the complete Honeywell **Fire Detection and Alarm System.** Ideally suited for reporting fires automatically, both within the building and to the local fire station, it offers these unique features—

- *More dependable*—transmits alarms even with a ground or break in detection circuit.
- *Positively locates fires* by numbered light—no need to count bell strokes to identify zone.
- *Stand-by battery* provides protection even when power fails.
- *Automatic detectors* fit standard 3" outlet box or plaster ring.

Other Honeywell electrical systems which help increase your contracts are:

The Honeywell Hotel/Motel Master* replaces footsteps with cheaper, faster electrical signals, offers tremendous operating savings.

The Honeywell Light Saver* which supplements daylight with artificial lighting, has brought reductions in lighting bills as high as 80%.

With Honeywell electrical systems you get the kind of support that's never been offered before in this field.

Honeywell helps you plan and install the system, checks it out for you and provides complete service during your guarantee period.

For more information, fill out and mail the coupon.

Honeywell

First in Controls

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Dept. EC-5-91
Minneapolis 8, Minnesota

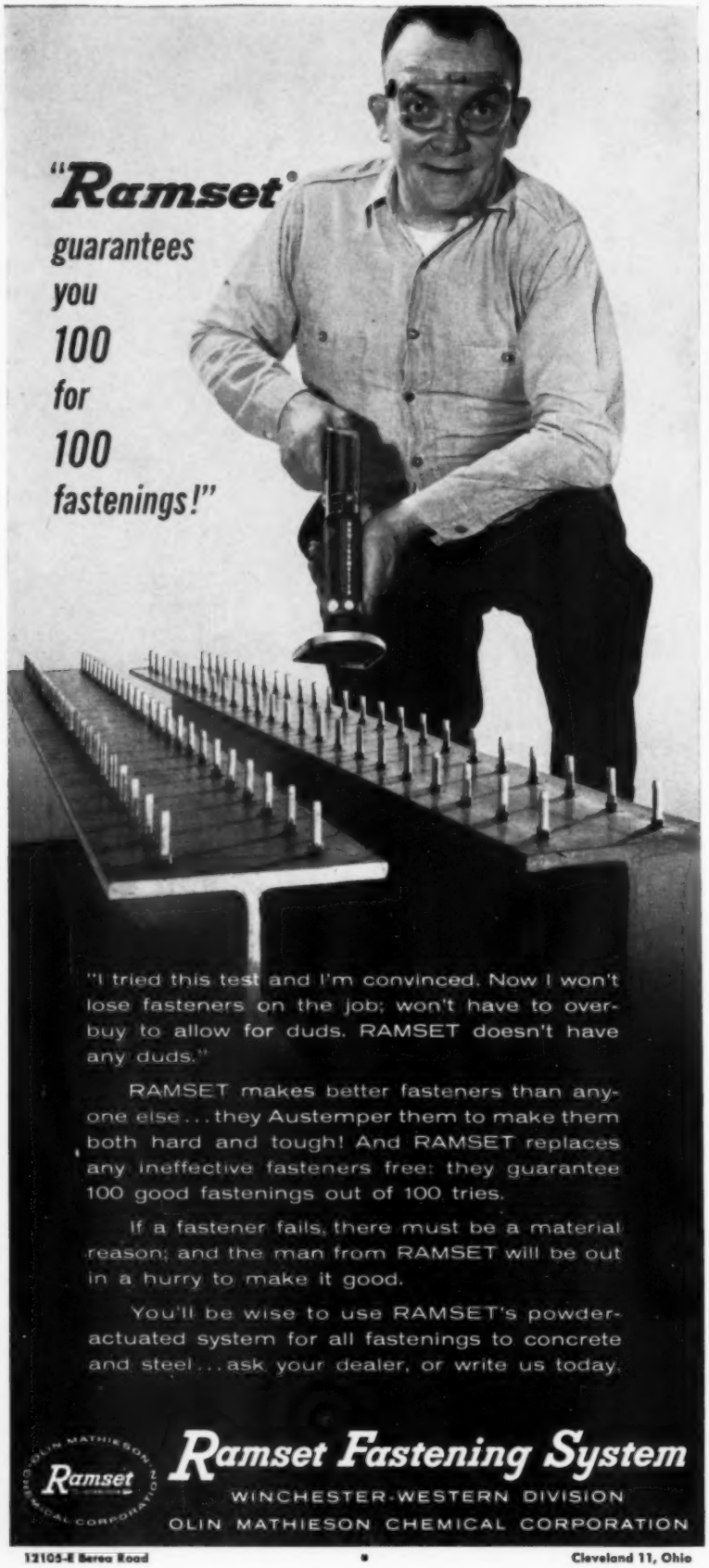
Please send me more information on:

☐ Honeywell Fire Detection and Alarm System
☐ Honeywell Light Saver ☐ Honeywell Hotel/Motel Master

*Name*_____

*Address*_____

*City*_____ *State*_____



11.0 Signal

be installed in the machine room located in the basement for controlling the load and the sequence of calls and the flashing of the lamps. To extinguish the lamp signals the reset button on the respective row is operated.

B. Central code transmitter, single call system: In corridors, stockrooms, shops and other locations shown on the plans, there shall be a heavy duty bar chime (single stroke bell, buzzer, or single projector vibrating horn). Adjacent to telephone switchboard operator there shall be an automatic motor-driven code transmitter with "on" and "off" switch and facilities for setting up a pre-determined series of codes or impulses. Only one signal may be transmitted at one time but may be repeated as desired. (Capacity of transmitter determined by the number of persons to be paged.)

C. Voice, multiple circuit system: In corridors, stockrooms, shipping room, shops and other locations shown on the plans, there shall be a loudspeaker. Adjacent to the telephone switchboard operator there shall be a desk type microphone with "press-to-talk" switch complete with flexible cable, plug and receptacle. In addition, there shall be a paging selector keyboard which shall enable the operator to connect each individual, group or riser of loudspeakers. A master switch shall be included to connect all loudspeakers simultaneously regardless of the position of the other switches.

11.43 Equipment

Aa. Install at each location shown a lamp annunciator with suitable mounting for the locality. Case shall be of heavy steel construction with hinged door. Single face flush, and double face, vertical wall bracket mounted annunciators shall have ten lamps each. Double face ceiling or suspended horizontal mounting and double face partition mounted annunciators shall have two sets of ten lamps each. Size of indicators shall not be less than 2 ins. high and shall have markings applied photographically or engraved on plastic sheet, Markings shall be 1 to 9 and 0. Buzzer shall be mounted in lower part of case and cutoff switch handle shall extend through bottom of case. (Where chime is mounted adjacent to annunciator, buzzer is omitted and two terminals are provided for extension.) Backbox to be provided by the manufacturer.

Ab. Install where shown a portable

(*Continued on page* 256)



"RCA Sound quality comes at the right price for any job!"

It'll pay you to look into that statement . . . pay you to get a price from RCA for *any* size sound system. There are five good reasons for selecting your RCA Engineered Sound Distributor as your equipment supplier . . . five good reasons for specifying RCA Sound in your next bid.

1. **Compare prices and you'll see that RCA Sound Quality costs no more.**
2. **All RCA components intermatch to work perfectly as a system and they're yours from a single reliable source.**
3. **Your RCA Engineered Sound Distributor will help you job-design an acoustically correct system for any requirement.**
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. . . AND

5. **RCA has a full set of helpful and interesting brochures, all of which you should have in your files before you start on your next set of sound specs.**



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SOUND PRODUCTS • CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

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Dept. F-41, Building 15-1, Camden, N. J.

Please send the RCA Sound brochures checked below.

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Name ..... Title .....

Company .....

Address .....

City ..... Zone ..... State .....



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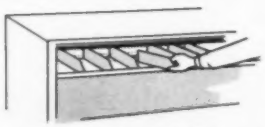
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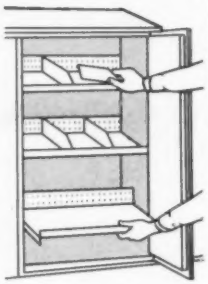


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READING BODY WORKS, INC., 420 Gregg Ave., Reading, Pa.

11.0 Signal

selector keyboard consisting of three rows of locking buttons or switches, each button in a row representing a single digit indication on the annunciators, and arranged parallel to each other. In addition, there shall be a "start" and a "stop" button, and an audible signal switch at the bottom of each vertical row. A flexible cable 10 ft long with multi-conductor separable plug and receptacle and flush terminal cabinet shall be provided for connection to the permanent wiring.

Ac. Install where shown a control panel enclosed in a surface steel cabinet with hinged door and lock with keys. This panel shall contain the necessary silent mercury contact relays, transformer for keyboard control, fuses, master switch and terminals.

Ba. Install where shown a heavy duty single stroke bar chime, single stroke bell (with 4-, 6- or 10-in. gong) buzzer, or vibrating horns as indicated by symbol. These units shall be wound to operate in multiple on the maximum voltage of the system. These shall be designed to mount on standard outlet boxes.

Bb. Install where shown a synchronous motor-driven automatic code transmitter having a selector keyboard or mechanical arm for setting the transmitter to call desired person. Index card or sheet shall be provided thereon for inserting the names of the individuals. A flexible cord and terminal box shall be provided for connection to 115-volt, 60-cycle, transformer and to connect to the signal circuit.

Bc. Install where shown a silent mercury contact or gravity silver contact relay or relays enclosed in surface steel cabinet with hinged door and connect with code transmitter. Relays shall be of sufficient size to carry the load of all signal devices.

Ca. Install where shown a permanent magnet, dynamic type loudspeaker single face flush, surface wall, double face wall bracket mounting or portable desk mounting as indicated by symbol. These speakers shall be of sufficient volume and size to be distinctly heard over the installation area.

Cb. Install where shown a portable type adjustable desk stand crystal microphone complete with flexible cable, plug and receptacle. A "press-to-talk" switch shall be provided on the microphone. (A floor type switch may be supplied with connecting cord to free operator's hand.)

Cc. A selector keyboard shall be

(*Continued on page* 258)



INTERLOCKED ARMORED CABLE

For Power Distribution in New Plants or in Modernizing Old Plants For more current capacity than cable in conduit or other armored cable, *specify and buy Rockbestos A.V.C.* . . . for easy installation on racks or hangers beneath the ceiling or next to walls, *specify and buy Rockbestos A.V.C.* . . .

. . . To eliminate costly conduits and ducts . . . to save important dollars on materials and installation time, to permit quick, easy repairs, *specify and buy Rockbestos A.V.C.*

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the BIG LINE of HEAVY-DUTY EXTENSIONS...

ROYAL ELECTRIC "POWR-KORD"

Safe, dependable Royal "Powr-Kords" stand up even under roughest usage because they're built strong to last long. MOLDED-ON caps and connectors with built-in strain reliefs are firmly vulcanized to top quality Royal Types S, SJ, or SJT cord. Heavy brass blades and double-wipe contacts . . . locked in solid rubber or vinyl . . . cannot wobble, work loose, or pull out.

FULLY UL LISTED

Colors . . . black and red rubber, red and yellow vinyl. (Safety engineers recommend yellow — the high-visibility safety color.)

Cord lengths . . . 10′ to 100′ rubber, 25′ to 100′ vinyl

Sizes and types

Type SJ	Rubber jacket, sizes 18 and 16 — 2- and 3-Conductor
Type S	Rubber jacket, sizes 18 through 12 — 2-Conductor
Type S	Rubber jacket, sizes 14 and 12 — 3-Conductor
Type SJT	Vinyl jacket, sizes 18 and 16 — 2-Conductor

Order rubber or vinyl "Powr-Kords" from your wholesaler, or write for Catalog No. 3-57, giving wholesaler's name.

ROYAL ELECTRIC CORPORATION
an associate of International Telephone and Telegraph Corporation
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provided with the microphone consisting of a portable cabinet containing a heavy duty switch for each individual, group or riser of loudspeakers and equipped with a flexible cable and terminal block in surface housing. A master switch shall also be provided below circuit switches.

Cd. Install where shown a voice paging amplifier equipped with volume control, tone control, power switch, protecting fuses, multi-tap output transformer, and receptacle for microphone, enclosed in ventilated steel cabinet. This unit shall be of ample capacity to operate the entire system.

11.44 Terminal strip cabinets

Install where shown on plans flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors, plus 10% spares. Terminal strips shall be mounted on a sheet of insulating material.

11.45 Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wires shall be color-coded and rubber covered. Feeder wires to control cabinets and relay cabinets shall be No. 12 B & S gauge. (A) Number of wires between the control cabinet or relay cabinet to annunciators: 11 without audible signals, and 12 with audible signals, with common feeder wire No. 12 B & S gauge and lamp and audible signal section wires No. 14 B & S gauge. (A) Number of wires between the keyboard and the control panel 15 wires without audible signals, and 16 with audible signals No. 16 B & S gauge. (B) Number of wires between the relay cabinet and sounding devices two not smaller than No. 14 B & S gauge. (C) Number of wires from amplifier to microphone one No. 18 B & S gauge rubber covered shielded twisted pair. Number of wires from selector keyboard to loudspeakers one No. 18 B & S gauge rubber covered twisted pair for each separate section of loudspeakers. The amplifier requires one pair of No. 14 B & S gauge wires from the source of supply.

11.5 Fire Alarm Systems

Note: The National Fire Protection Association has a specific code for fire alarm systems. This NFPA Code 72 is entitled, "Standards for the Installation, Maintenance and Use of

(*Continued on page* 260)

New Concept in Construction Fastening!

REMINGTON Power-Mate* BASIC UNIT



. . . plus choice of 4 interchangeable Stud Driver Kits



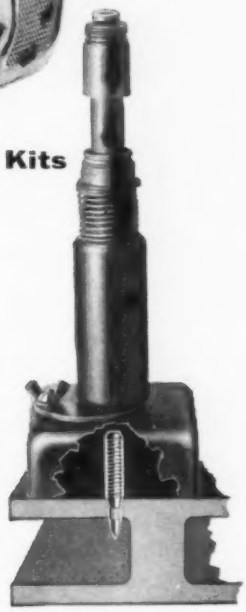
K-1. CAPTIVE STUD KIT—designed to prevent free flight of studs when base material is inadequate. Used with "Power-Mate," this is safest Stud Driver ever designed.



K-2. LIGHT-DUTY KIT—produces all-purpose tool. Handles 80% of your fastening in concrete or steel. K-1 and K-2 use ¼" diameter Remington Studs and 22 caliber Power Loads.



K-3. MEDIUM-DUTY KIT permits use of ⅜" diameter Remington Studs with low-cost 22 caliber Power Loads. This assembly gives top performance . . . economically.



K-4. MEDIUM- AND HEAVY-DUTY KIT for toughest fastening jobs. Designed for use with ⅜" diameter Remington Studs and scientifically graded 22 or 32 caliber Power Loads.



Most versatile tool ever designed for fastening wood or metal to concrete or steel

Now you can have the power you want, the stud size you need with the new Remington "Power-Mate." The tool is easy to use. Just a squeeze of the trigger is all it takes to anchor wood or metal sections to concrete or steel. No pre-drilling, no outside power connections required!

The Remington "Power-Mate" is flexible, too. Permits use of ¼" or ⅜" diameter alloy steel studs and 22 or 32 caliber Remington Power Loads to furnish driving force.

Take the "Power-Mate" Basic Unit, attach the Stud Driver Kit of your choice—and the tool is ready to use! It will handle any fastening job—light, medium or heavy duty. That's why the Remington Stud Driver is the most versatile construction fastening tool ever designed!

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STUD DRIVER

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the best switch for all on-off circuit applications...



SANGAMO
HEAVY-DUTY TIME SWITCHES

automatically control switching schedules in exact accordance with your specific needs

Put Sangamo Heavy-Duty Time Switches, equipped with astronomic dials, to work in your lighting installations. Years of dependable, accurate and trouble-free service prove these the best switches for all on-off circuit applications.

Sangamo's astronomic dial controls switching schedules automatically in exact accordance with sunset and sunrise, or off before midnight, if you wish. It compensates progressively day by day for the change in the length of daylight and is available for all latitudes.

Only Sangamo Heavy-Duty Time Switches also offer the electrically-wound automatic carryover which keeps switch running for as long as 10 hours during power outages. No resetting or rewinding is necessary.

Your Electrical Wholesaler can furnish you with all types of dependable, accurate Sangamo Time Switches. See him, today, for full information.

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Now is the TIME to SWITCH to SANGAMO

11.0 Signal

Proprietory, Auxiliary, Remote Station and Local Protective Signaling Systems, including Local or Isolated System for Watchman, Fire Alarm and Supervisory Service." It is recommended that those writing fire alarm systems specifications obtain a copy of NFPA Code 72 from the National Fire Protection Association, 60 Battery March, Boston, Mass., and become familiar with its requirements. The specifications as described below follow the general requirements of NFPA Code 72 and it is recommended that the specifications state "The system shall meet the requirements of NFPA Code 72," and be listed by the Underwriters' Laboratories.

A. Non-coded, closed-circuit, supervised.

B. Master-coded, closed-circuit, supervised.

C. Coded, closed-circuit supervised.

D. Coded pre-signal, closed circuit supervised.

E. Coded auxiliarized, municipal connection.

F. Non-coded automatic, closed-circuit, supervised.

G. Zoned automatic, low voltage, closed circuit, supervised.

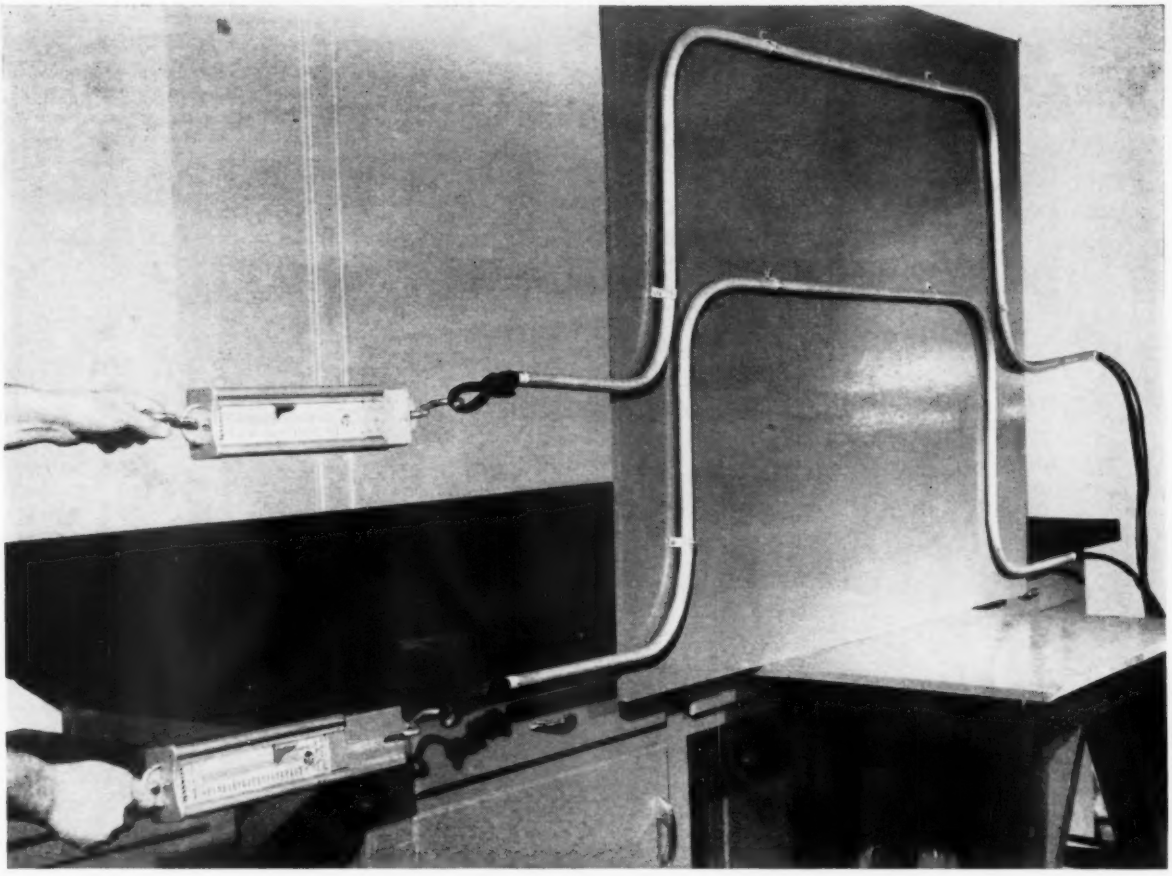
7.51 General

Furnish and install a (trade name and/or number) fire alarm system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first-class operating conditions.

7.52 Operation

A. Non-coded, closed-circuit, supervised system: At each stairway, exit, and other locations shown on plans, there shall be a non-coded fire alarm station. At each location where shown, there shall be a bell (or horn). Operating any station shall cause all sounding devices to operate continuously until the fire alarm station has been restored to normal. It shall also be possible for those in authority to transmit a test signal from any station by opening the front of the front of the cover. The stations and the sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire system. A trouble bell shall also be provided and shall sound continuously in the event of failure of

(*Continued on page* 262)



Cables 50% easier to pull

with Rome's new invisible lubricant!

Two almost identical groups of wire of the *same* size were pulled through *identical* lengths of ½" conduit. *Yet, one group was 50% easier to pull!* Why?

An Actual Test

In the illustration above, you can see that the force needed to pull nine wires (No. 14 AWG) through the bottom section of conduit was approximately 150 pounds. These wires were coated with the conventional paraffin-type lubricant.

Now, note the top half of the test. Same *size* wires. Same *number* of wires. Same ½" *conduit*. But–*these* wires were coated with the new Rome Cable emulsion. Pulling force needed: Less than 75 pounds. Less than *half* the pulling force needed for paraffined wire. You can't see the coating–but, you *can* see the result, and it's permanently bonded to the insulation.

Easier Installations

This new improvement in wire coating can save money for you. With wire and cable pulling easier, you cut installation time and labor costs. There's no problem with the coating flaking off because it is virtually "married" to the insulation. Rome's new emulsion will not "pile up" to plug conduit or "freeze" cables in position.

Furthermore, extensive heating and aging tests have proved that this new emulsion coating will not be absorbed by the insulation, nor will it disappear through volatilization.

Available now

This new extra-low-friction coating is now standard on many of the Rome wires and cables which have Rome Synthinol insulation. A list of wires and cables coated with the new emulsion is shown at the right.

The next time you order building wire, be sure to ask your electrical distributor about Rome Cable's new emulsion-coated, easy-to-pull building wire.

New invisible lubricant now available on these Rome wires and cables:

- Rome Synthinol building wires and cables, Type TW–600 volts.
- Rome Synthinol 901 wires and cables for extra heat and corrosion resistance, Type TW–600 volts.
- Rome FlexAll cable, Types UF and NMC–600 volts.

324

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Weatherproof

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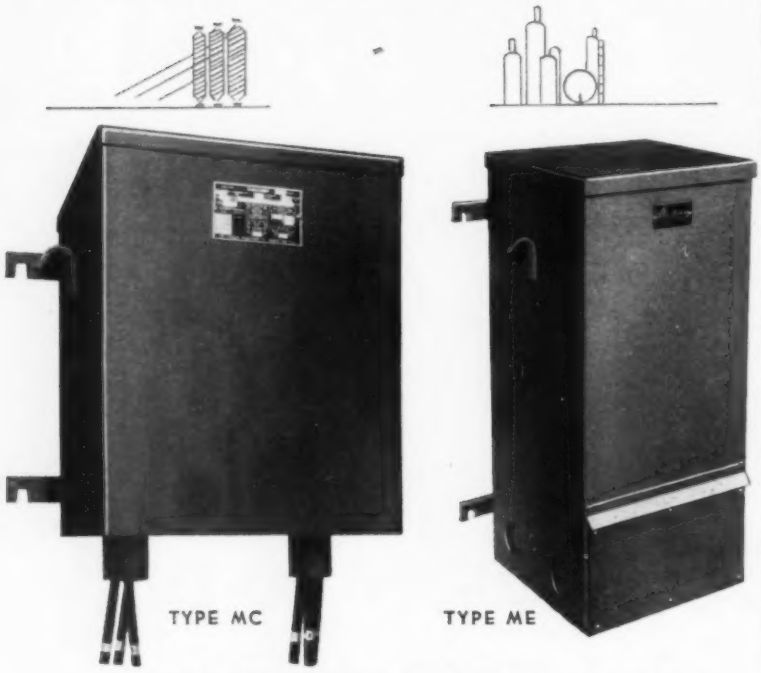
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Standard Type MC low voltage transformers are designed for use wherever explosion-proof equipment is required. Standard is now specified by most major oil companies and these units are used in hazardous or dust-laden locations. Windings are not exposed to lint, dust and dirt. These air-cooled, dry-type, compound filled transformers are efficient, compact units designed for indoor or outdoor service. Special all-welded steel cases are available. Type MC is designed in sizes through 15 KVA only and ratings through 600 V—single or three phase.

Type ME is designed with Class H insulation in sizes through 150 KVA and ratings through 4800 V—single or three phase. These are completely sealed units but are not compound filled.

Both types are available with terminal chambers or conduit nipples with leads brought out as illustrated.

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"WHEREVER THERE IS POWER"

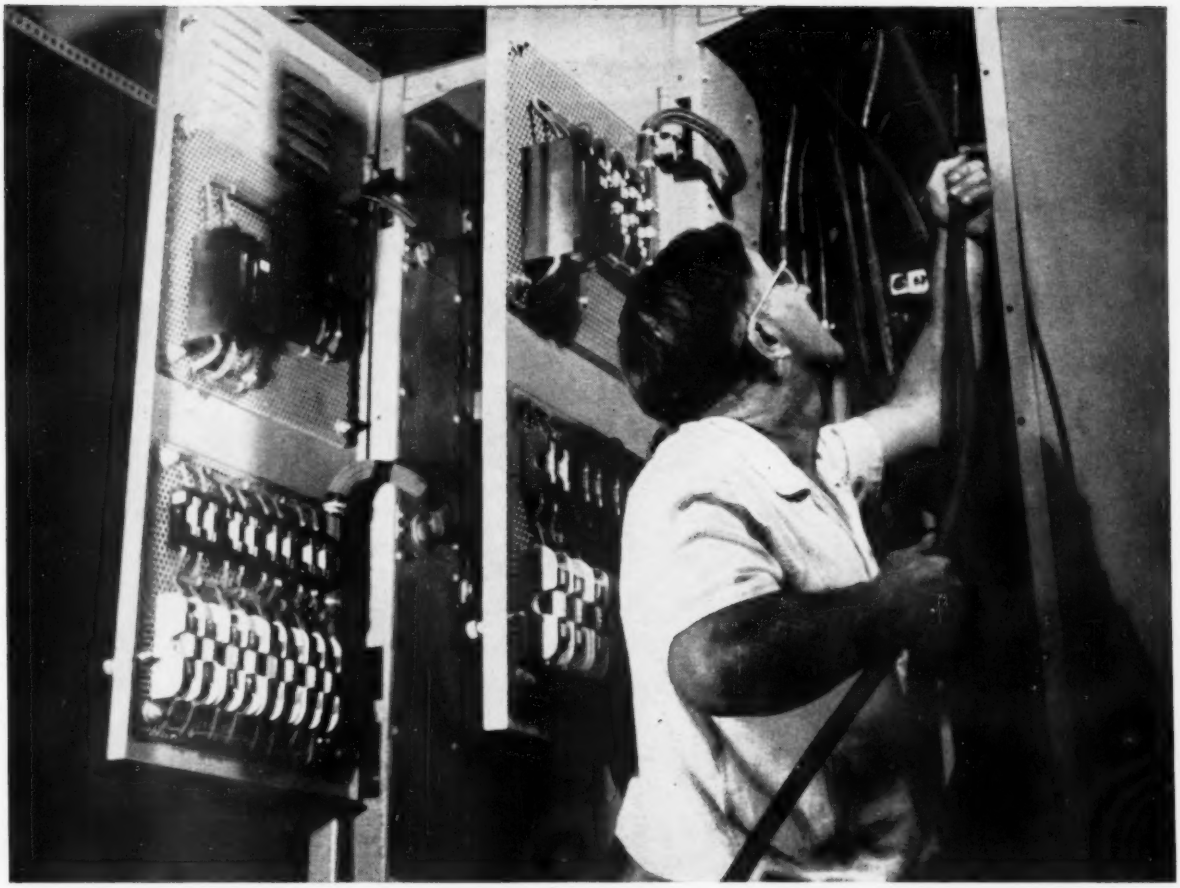
the main power supply source or a break or a ground fault of its installation wiring circuits.

B. Master-coded, closed-circuit, supervised system: At each stairway, exit and other locations shown on plans, there shall be a non-coded fire alarm station. At each location shown, there shall be a bell (or horn). Operating any station shall cause the master code mechanism on the control panel to transmit a common code (such as 4-4) on all sounding devices in the system. It shall also be possible for those in authority to transmit a test signal from any station by opening the front cover by means of a key. The station and the sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire system. A trouble bell shall also be provided and shall sound continuously in the event of failure of the main power supply source or a break or ground fault of its installation wiring circuits.

C. Coded, closed-circuit, supervised systems: At each stairway, exit and other locations shown on the plans, there shall be a coded fire alarm station. At each location shown there shall be a bell (or horn). Pulling and releasing the lever of any station shall cause the code number of that station to be sounded four times on all signal devices in the system. The stations and the sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire system. It shall be possible to make a single tap test, and a silent running test on any station by operating an enclosed lever or by inserting a key into an opening provided therefore, and turning it in either of two directions. A trouble bell shall also be provided and shall sound continuously in the event of failure of the main power supply source or a break or ground fault of its installation wiring circuit.

D. Coded pre-signal, closed-circuit supervised system: At each stairway, exit and other location shown on plans, there shall be a coded pre-signal fire alarm station. At each location there shall be a general alarm bell or a pre-signal bell or chime as indicated. Pulling and releasing the lever of the station shall cause the code number of that station to be sounded four times on all pre-signal devices only. Inserting a special key in an opening of any station and then pulling and

(*Continued on page* 264)



When control panel squeeze pinches your profits you need Rome's easy-to-install control cable



When you're in a tight spot—You can depend on Rome's "CT-2" control cable to take up much less space and let you make connections faster and easier.

Here's the way to speed up making complex control-panel connections in tight quarters. Install a control cable that's easy to work with—even in limited space requirements.

You'll find just such a cable is Rome's "CT-2" control cable. Its smaller diameter will fit even into those panels that are already "tight." It's lightweight, too, and easy to pull through conduit.

Faster installation . . . more profit

Don't spend unnecessary time laboring over connections in panels already packed with a lot of control cable. Because it's slim and trim, Rome's control cable lets you make these connections quickly and efficiently—*even* in those "tight spots." With Rome's Rolene insulation you get clean, positive stripping. And you can make sure and dependable terminations—for a more efficient installation. The Synthinol (PVC) sheath* has a smooth surface which makes it easy to handle when you feed it off the reel.

This ease of installation adds up to faster jobs and greater profits . . . each time you work in tight quarters (or anywhere else) with Rome's "CT-2" control cable.

Use Rome's control cable for your next job where you find a control panel squeeze. For more information, contact your nearest Rome Cable representative—or write to Department 854, Rome Cable Corporation, Rome, N. Y.

*Alternate sheaths of Rolene (polyethylene) or Roseal (flame-resistant polyethylene) are also available.

ROME CABLE

CORPORATION



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Only "Servisafe" Poles give you the combination of speed, safety and savings in servicing pole-mounted lights. All work is accomplished at ground level. That's why one unskilled man can relamp and clean a light in an average of five minutes. He is safe from climbing and electrical hazards . . . needs no special equipment or assistance.

"Servisafe" Poles also permit greater luminaire mounting heights. This means fewer poles are required to illuminate a specific area . . . assures additional long-range savings.



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T-E

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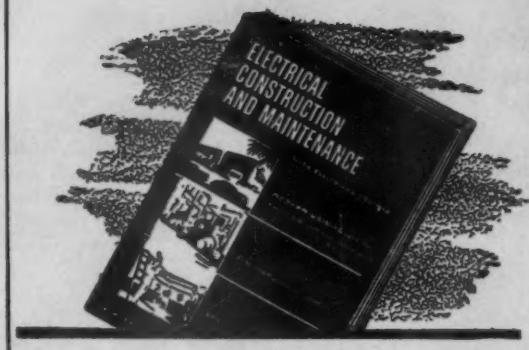
7753-TE

releasing the lever shall cause the code number of that station to sound on all signal devices, both pre-signal and general alarm throughout the system. The station and sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire system. It shall be possible to make a single tap test, and a silent tuning test on any station by operating an enclosed lever, or by inserting a key into an opening provided therefore, and turning it in either of two directions. A trouble bell shall also be provided and shall sound continuously in the event of failure of the main supply source or a break or a ground fault of its installation wiring circuit.

E. Coded auxiliarized, municipal connected system: At each stairway, exit and other locations shown on plans, there shall be a coded, auxiliarized fire alarm station. At each location, there shall be a bell (or horn). Pulling and releasing the lever of the station shall cause the code number of that station to be sounded on all signal devices in the system four times and transmit the alarm simultaneously to the City Fire Department by tripping an auxiliarized City Master Fire Alarm Station on the premises. A test of the system and a silent running test of the mechanism in the stations may be conducted from any station without sending an alarm to the City Fire Department. The stations and the sounding devices shall be connected to a control panel, which shall permit a small supervisory current to pass through the entire system. A trouble bell shall also be provided and shall sound continuously in the event of failure of the main power supply source or a break or a ground fault in its installation wiring circuit.

F. Non-coded, automatic, closed-circuit, supervised system: In all rooms, corridors, closets, shops, storerooms, attic and other locations shown on plans, there shall be mounted on the ceilings, detectors, properly spaced and installed to result in maximum protection in accordance with the Underwriters' rated spacings of the detectors to be used. At each location there shall be a bell (or horn) and at least one non-coded manual fire alarm station per floor. The automatic operation of any detector or the manual operation of any station shall cause all sounding devices to operate continuously throughout the system. The

(*Continued on page* 266)



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Nature of Co. Business.....

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Operate a motor repair shop?

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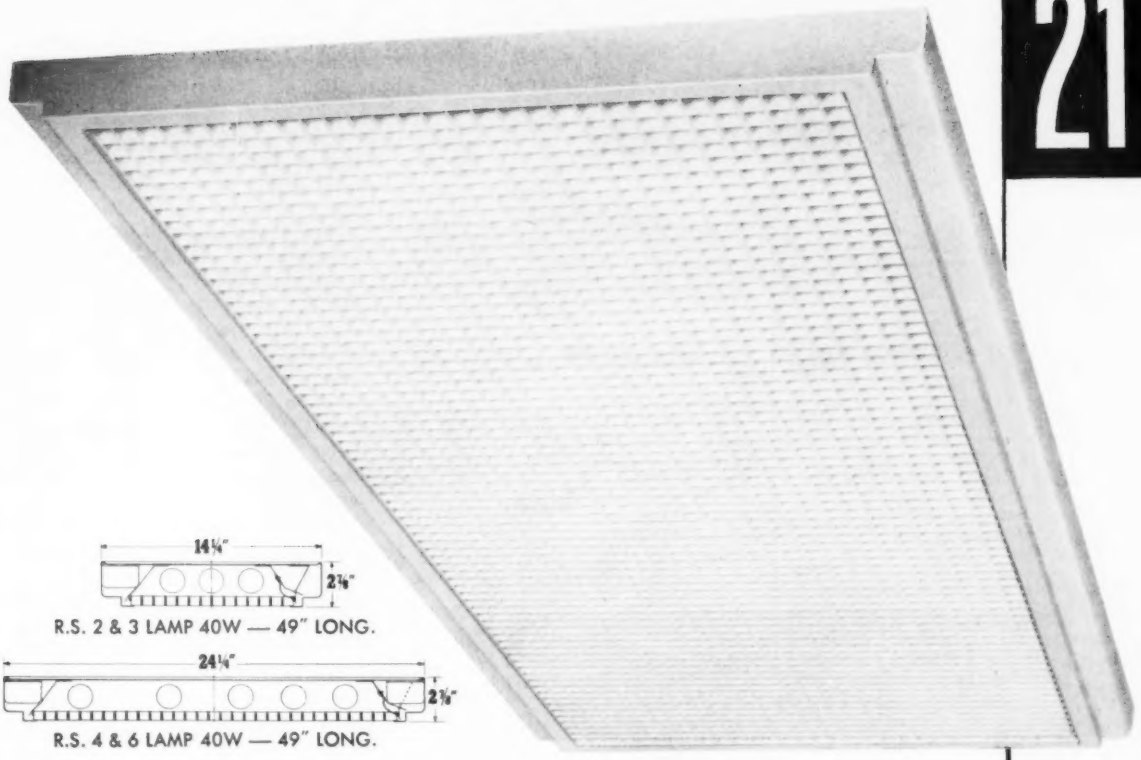
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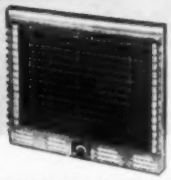
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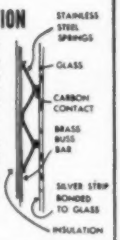
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Power leads are brought to heating element by means of an exclusive Buss Bar assembly. Multiple spring loaded carbon contacts are utilized to assure a positive and dependable connection.



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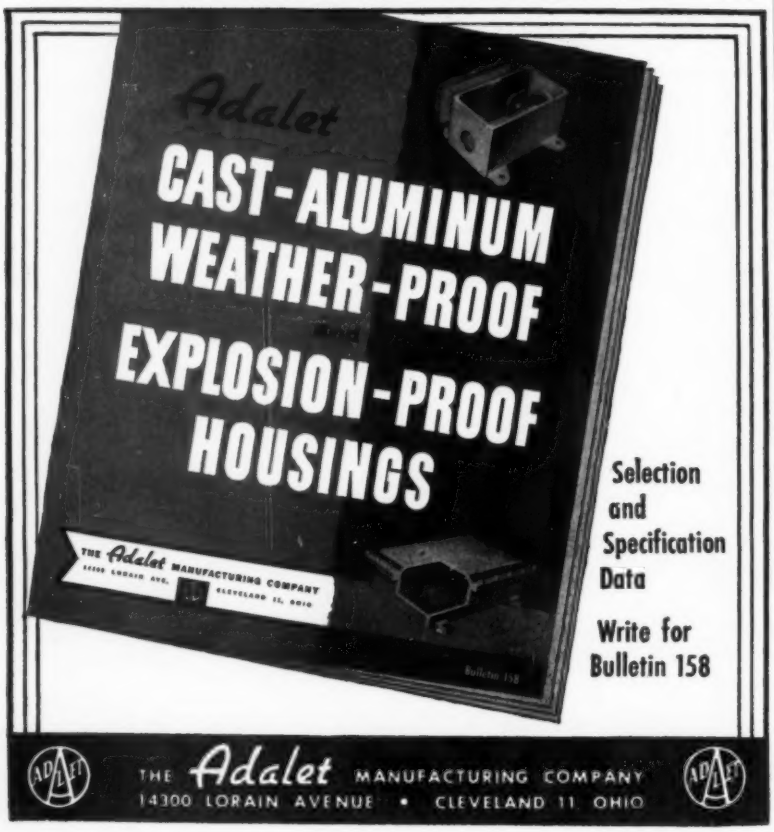
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11.0 Signal

detectors, manual stations and sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire wiring of the system. A trouble bell shall also be provided and shall sound continuously in the event of failure of the main power supply source or a break or a ground fault of its installation wiring circuits. The trouble bell shall include a transfer switch and a pilot light mounted on the control panel.

G. Zoned, automatic, low voltage, closed-circuit supervised system: In all rooms, corridors, closets, shops, storerooms, attic and other locations shown on plans there shall be mounted on the ceilings, detectors properly spaced and installed to result in maximum protection in accordance with the Underwriters' rated stations of the detectors used. At each location shown, there shall be a bell (size and number of bells so located that they may be heard by all occupants of the building) and at least one non-coded manual fire alarm station per floor. The detectors and their associated manual stations shall be wired in zones so as to indicate at the control panel the location (by zone) of the fire. In addition, the operation of any detector or a manual fire alarm station shall cause all sounding devices to operate continuously until the operated detector or manual station has been restored to normal and a reset button in the control panel has been pressed. The detectors, manual stations and sounding devices shall be wired and connected to a control panel which shall feed a small supervisory current to the wiring to the detectors and manual stations. A trouble bell shall also be provided and shall sound continuously in the event of failure of the main power supply source, or a break of the detector and manual station installation wiring circuit. The trouble signal shall include a transfer switch and a pilot light mounted on the control panel.

7.53 Equipment

Aa. Install where shown a flush (or surface) non-coded (1) breakglass or (2) non-breakglass manual fire alarm station, with hinged front door arranged for making tests without breaking glass, and for easy replacement of the glass when broken. Flush station shall mount on standard outlet box with single gang cover. (Surface stations are provided with backcasting by manufacturer.)

(*Continued on page* 268)

MORE LIGHT for the MONEY with the NEW POWER-GROOVE INDUSTRIALS by SMITHCRAFT

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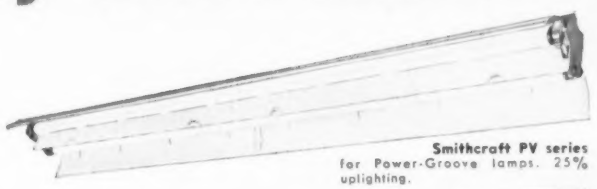
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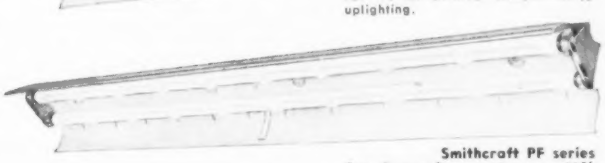
THE MAN FROM SMITHCRAFT

Paul Wehner, Dayton, Ohio representative. Like every member of Smithcraft's nationwide sales organization, his ability to talk your language can mean a lot to your profit picture.

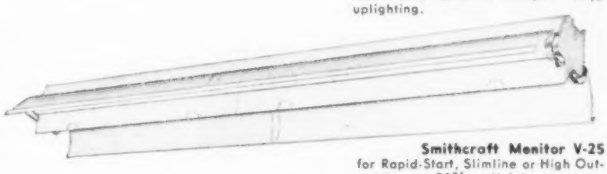
Smithcraft "AMERICA'S FINEST FLUORESCENT LIGHTING"



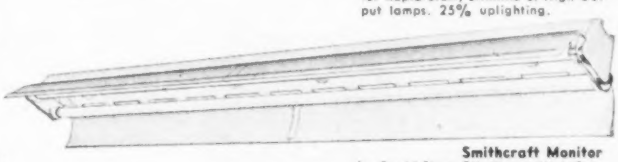
Smithcraft PV series for Power-Groove lamps. 25% uplighting.



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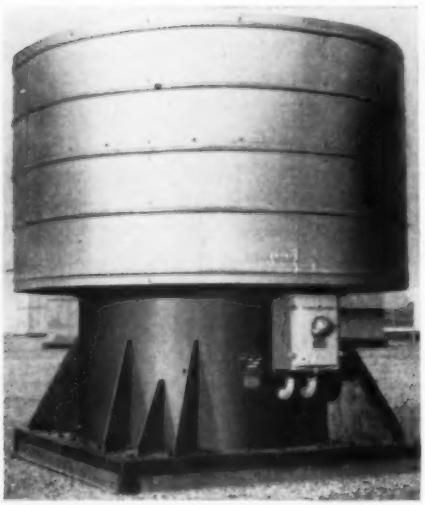
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11.0 Signal

Ab. Install where shown on plans an underdome vibrating bell (4-, 6-, or 10-in size), or heavy duty type vibrating horn of the grille type as indicated by symbol. Note: Size and number of signals to be located so that they may be heard by all occupants of the building.

Ac. Install where shown a closed-circuit fire alarm control panel in surface (or flush) wall type steel cabinet equipped with hinged door with lock and keys. Panel shall contain all necessary relays, meter, resistances, thermal cut-out, terminals and fuses for the control and supervision of the system. Panel shall operate on 115/230 volts, 60-cycle, 3-wire supply current. Panel shall contain number of bell and station circuits required. A trouble bell shall be provided for external connection.

Ba. (Same as paragraph Aa.)

Bb. Install where shown in underdome single stroke plunger type bell (4-, 6-, or 10-in. size) chime or heavy duty vibrating horn of the grille type as indicated by symbol. Note: Size and number of signals to be located so that they may be heard by all occupants of the building.

Bc. Install where shown a closed-circuit fire alarm control panel of the master coded type in surface (or flush) wall type steel cabinet equipped with hinged door with lock and keys. Panel shall contain all necessary relays, meter, resistances, thermal cutout, master code movement, terminals and fuses for the control and supervision of the system. Panels shall operate on 115/230 volts, 60-cycle supply current. Panel shall contain number of bell and station circuits required. A trouble bell shall be provided for external connection.

Ca. Install where shown a semi-flush (or surface) coded, pull lever, 4-rounds (1) non-breakglass or (2) breakglass fire alarm station. The station shall be provided with a code wheel, coded as required. Facilities shall be included for making a single tap test and silent running test. Backbox to be provided by the manufacturer.

Cb. (Same as paragraph Bb).

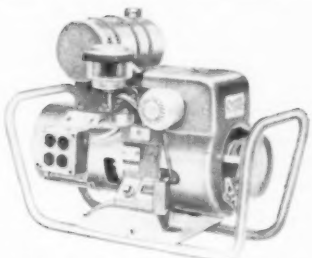
Cc. (Same as paragraph Ac.)

Da. Install where shown a semi-flush (or surface) pre-signal, pull lever four round (1) non-breakglass or (2) breakglass fire alarm station. Station shall be provided with a code wheel, coded as required. A lock and key shall be provided on the cover for transmitting a general alarm. Facilities

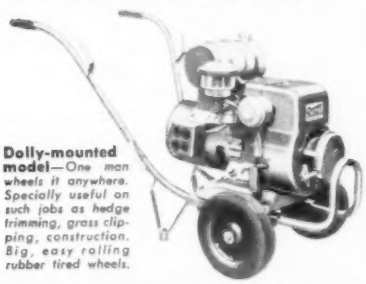
(*Continued on page* 270)

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Standard Model *For installation in maintenance trucks, on fire rigs etc. Converts to portable model with carrying frame or dolly.*

See your Onan distributor or write for information

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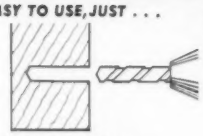
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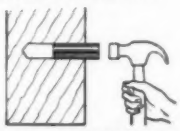
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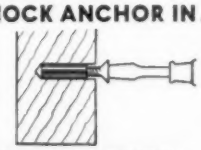
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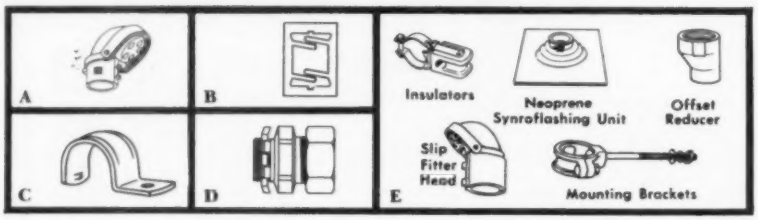
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A SLIP FITTER HEAD made of ductile aluminum. No rusting or discoloration. Simply slip over conduit and tighten two set screws. Available in 2" and 2½" units.

B 540 BOX SUPPORT one piece box support. Provides rigid, unified support. Tabs are bent to inside of box, holding it tight. Broad, single support surface won't wobble or cut.

C SNAP STRAP snaps tighter. Has exclusive "hold bump." Ribbed bracket adds to the snap, provides rigid contact support of the conduit or EMT. Wide range of sizes. Quickly installed.

D EMT CONNECTOR has full, true, perfect threads for ease and speed of installation. Rain-tight. Finished in zinc to eliminate corrosion. Complete range of sizes.

E SERVICE ENTRANCE MAST ASSEMBLY consists of Slip Fitter Head, Synroflashing unit, Offset Reducer, Mounting Brackets and Insulators. The mounting brackets attach to vertical studding, support entire service drop strain. This eliminates water leakage at penetration point and vibration strain to rafters and roof.

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11.0 Signal

shall be included for making a single tap test and silent running test with key or lever. Back box for the installation to be provided by manufacturer.

Db. (Same as paragraph Bb.)

Dc. (Same as paragraph Ac.)

Ea. Install where shown a semi-flush (or surface) pull lever, four round, (1) non-breakglass or (2) breakglass coded type fire alarm station. Station shall be provided with a code wheel coded as required with municipal alarm interlocking contacts for operating the auxiliarized City Master Fire Alarm Station. The station shall be arranged to permit fire drills without sending alarms to the municipal system. Backbox to be provided by the manufacturer.

Eb. (Same as paragraph Bb).

Ec. Install where shown a closed-circuit fire alarm system control panel in surface (or flush) wall type steel cabinet equipped with hinged door with lock and keys. Panel shall contain all necessary relays, meters, resistances, thermal cutout, terminals and fuses for the control and supervision of the interior system, and separate terminals for connection to the municipal system. Panel shall operate on 115/230 volts, 60-cycle, 3-wire supply current. Panel shall contain number of bell and station circuits required. The trouble bell shall be provided for external connection, together with trouble pilot light and silencing switch.

Fa. Install where shown thermostatic detectors of the rate-of-rise and/or fixed temperature type with open circuit contacts and mounted on round outlet boxes and covers for operation on 136° F. (or 190° F.).

Fb. (Same as paragraph Aa.)

Fc. (Same as paragraph Ab.)

Fd. (Same as paragraph Ac.)

Ga. (Same as paragraph Fa.)

Gb. (Same as paragraph Aa.)

Gc. (Same as paragraph Ab.)

Gd. Install where shown a closed circuit fire alarm control panel in surface (or flush) wall type steel cabinet equipped with hinged door with lock and key. On the door there shall be as many pilot lamps as there are zones and a trouble lamp and an alarm lamp. On the fire alarm control panel, there shall be mounted the necessary relays, trouble bells, with cutoff switch and signal reset buttons and wiring terminals. The panel shall be operated from the secondaries of two 100-watt signaling transformers (one transform-

(*Continued on page* 273)

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No. 5203 } 30-watt
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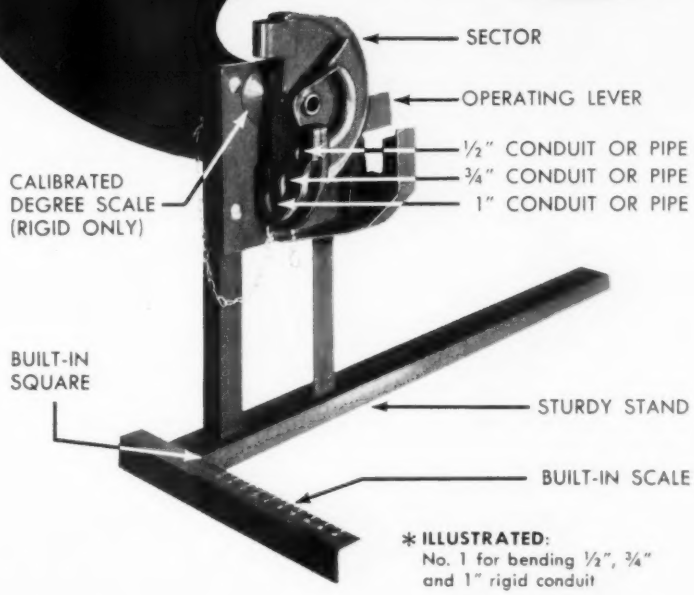
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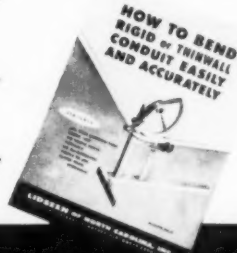
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¾" conduit or pipe	4¼"	EMT 4½"
1" conduit or pipe	5¾"	EMT 6½"
	No. 2	**No. 2T**
1¼" conduit or pipe	7⅛"	EMT 9½"
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11.0 Signal

of to operate the system and the other to operate the trouble bell. The primaries of these transformers shall be connected to a 115/230-volt, 3-wire, 60-cycle supply current.

11.54 Wiring

Service connection to the system shall be made on the house side of, and as near as possible to the meter. All interior wiring shall be in strict accordance with NFPA Codes 70 and 72 and all local electrical codes applying. Size and number of wires shall be in accordance with wiring diagram supplied by manufacturer of fire alarm system.

11.6 Electric Clock Systems

A. Synchronous wired dual-motored clocks, central control system.

B. Master time control with synchronous wired clocks, system.

C. Master time control with minute impulse wired clocks, system.

D. Electronic controlled synchronous clocks, system.

11.61 General

Furnish and install a (trade name and/or number) electric clock system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first class operating condition.

11.62 Operation

A. Synchronous wired dual-motored clocks, central control system. Each clock of the system is equipped with two motors. During normal operation, the "normal" motor in each clock operates at normal rate. When a power interruption occurs, the clocks of the system stop and when power returns, all clocks start again automatically, but are slow to the extent of the power interruption. The second or "reset" motor in each clock is used to advance the clocks at an accelerated rate until correct time is reached. The reset motors may also be used to advance all clocks from Standard to Daylight Saving Time. Two types of central control are available, i. e., (1) Switch reset and (2) Automatic reset. (NOTE: The switch reset control is recommended where power supply is reliable with infrequent interruption and the automatic control should be used where

(*Continued on page* 274)



No wonder the "pros" have bought hundreds of thousands of them, the easy way they snap into the ratchet ring handle . . . the smooth clean way they cut ⅛" to 1" threads . . . the quick way these conduit dies reverse for close-to-wall threads. You'll like OOR's, too—get 'em at your Supply House.

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power supply is subject to frequent interruption and/or it is desirable to have several clocks running continuously regardless of power interruption.) (1) The switch reset control shall be equipped with a red pilot lamp to indicate when there has been a power interruption and with two key switches, one to advance the clocks and the other to stop the clocks (as would be required to change the system from Daylight Saving to Standard Time or for repairs to the system. (2) The automatic reset control, automatically advances all clocks to correct time upon restoration of power after a power interruption (up to 12 hours) and is equipped with reserve power to operate several clocks during power interruptions. The control is also equipped with switches for making time changes.

B. Master time control with synchronous wired clocks, system. Each clock of the system is equipped with a synchronous motor and correction mechanism and is individually checked with the master time control once each hour and once each 12 hours. In the event of power failure, the clocks will stop but upon power restoration will be corrected at a pre-selected minute within the hour for power failures of less than one hour duration and at a pre-selected hour for duration, and at a pre-selected hour will be corrected for power failures up to 12 hours duration.

C. Master time control with minute impulse wired clocks, system. Each clock of the system shall receive an impulse from the master time control, once a minute which shall advance the clocks one minute. Each hour, rapid impulses are emitted from the master control to provide automatic hourly supervision of the clocks, and these impulses shall also restore the clocks to correct time upon power being restored after a power interruption.

D. Electronic controlled synchronous clocks, system. Each clock is synchronous motor-driven and is wired to a 115-volt ac source. The clocks are individually checked for agreement with the master time control once each hour by a carrier current pulse which is superimposed on the lighting bus or main distribution by transmitting equipment controlled and operated in conjunction with the electronic master time control. The clocks are equipped with a correction mechanism and an electronic signal receiver and when varying from system time be-

cause of power failure up to 12 hours slow, will be corrected at a pre-selected minute within the hour for power failures of less than one hour duration and at a pre-selected hour for power failures of more than one hour.

11.63 Equipment

Aa. In a central location, install (1) a switch reset control unit, consisting of power interruption pilot lamp, indicator relay and two key-type switches mounted on a 2-gang subplate with stainless steel faceplate for flush mounting. The faceplate shall be engraved to identify the one switch as "Advance" and the other as "OFF." (2) Automatic reset control complete with power unit for automatic correction of the system clocks after power interruptions up to 12 hours duration and with manual switches to make time changes. This control shall be furnished in flush (or surface) steel cabinet with hinged door with lock and key.

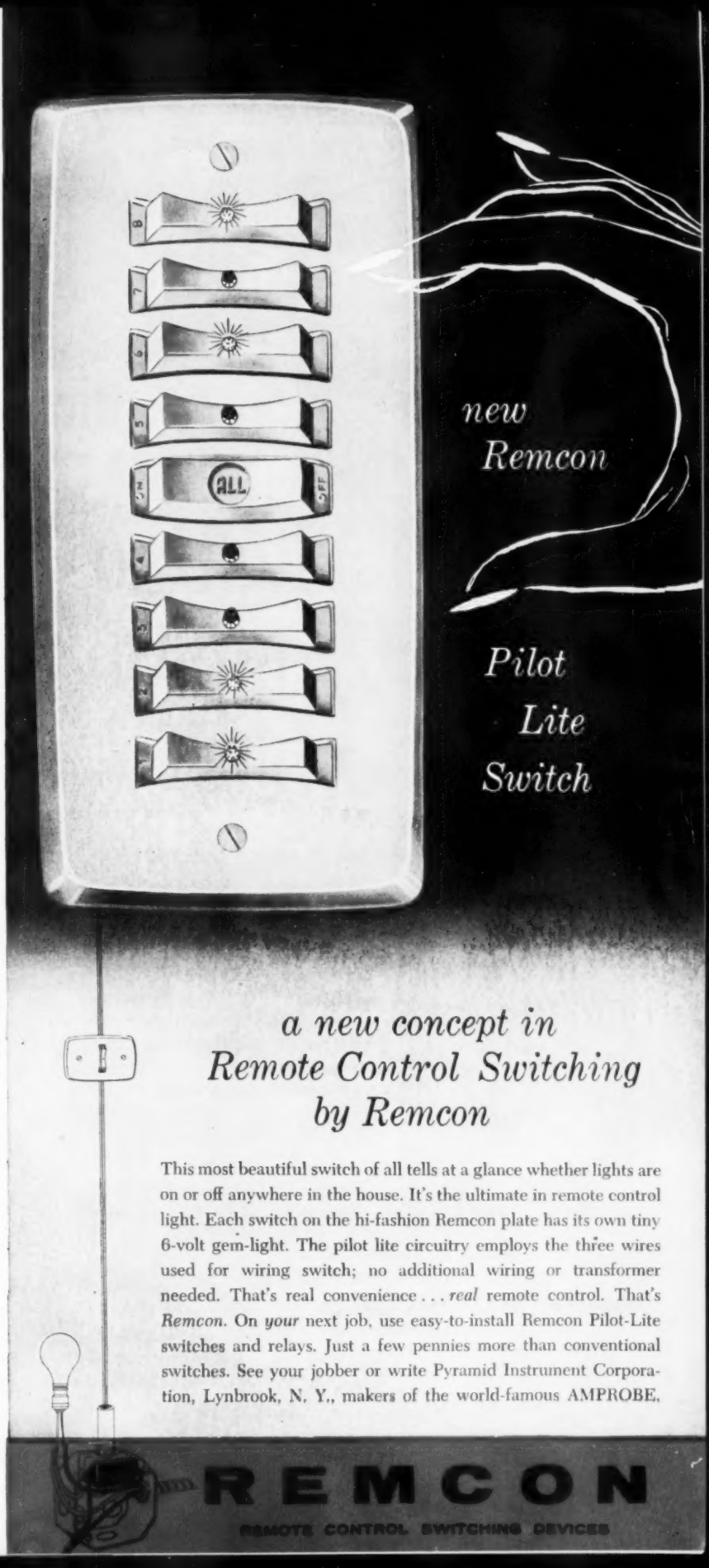
Ab. Install in rooms as indicated on the plans flush (or surface), clocks having an 8-, 12-, 15- or 18-in., dial with metal case with convex crystal glass black hour and minute hands and red sweep second hand. In the corridors, install double face clocks either ceiling or wall mounted (as specified) having 8-, 12-, 15-, or 18-in. dials with metal cases and convex crystal glass. In those locations where the crystal is subject to damage, such as in gymnasiums, the crystal shall be furnished with shatterproof glass for protection.

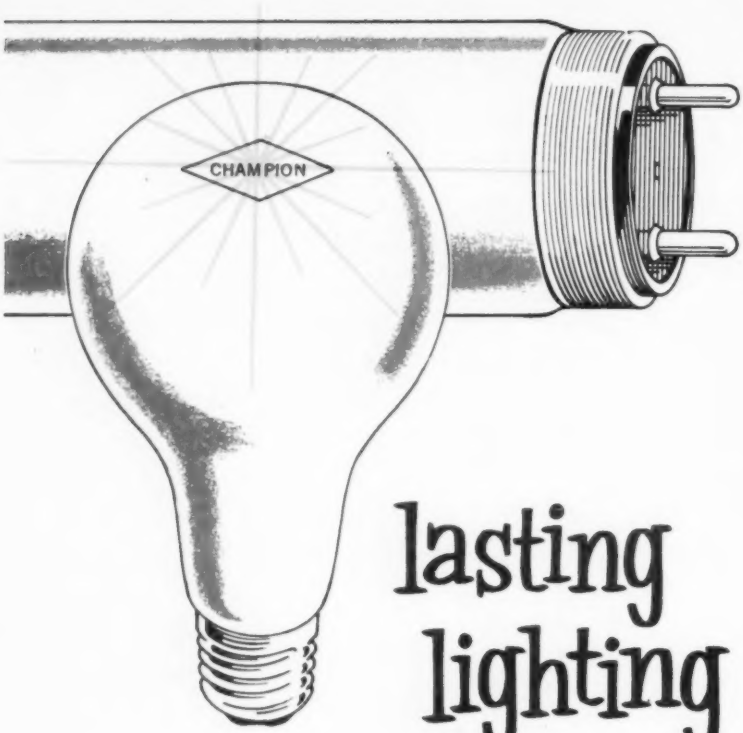
Ba. In a central location, install a synchronous motor-driven self-regulating master time control having reserve power to automatically correct all the clocks in the system, to correct time after a power interruption of up to 12 hours duration. The control shall also automatically correct any individual clock for fast or slow operation once each hour and in addition shall provide for the automatic correction of any individual clock or group of clocks when slow up to 12 hours. The control unit shall be housed in a metal case flush (or surface) with pilot clock.

Bb. Same as Ab.

Ca. In a central location, install a synchronous motor-driven self-regulating master time control with necessary power equipment to send an impulse once a minute to all clocks in the system. The control shall also automatically correct all clocks in the system to correct time after a power interruption of up to 12 hours dura-

(*Continued on page* 276)





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tion and once each hour correct any individual clock for fast or slow operation. The entire unit shall be housed in a metal case flush (or surface) with pilot clock.

Cb. Same as Ab, except without sweep second hand.

Da. Same as Ba.

Db. Install as indicated on the plans the necessary transmitting units complete with power transformer, tubes, relays and terminal strips, which shall be operated by the master time control (Da) which shall cause a carrier frequency pulse to be superimposed on the existing ac lighting sources. This pulse shall be received by an electronic receiver built into the individual indicating clocks. Determining capacity of the transmitter equipment shall be the responsibility of the equipment manufacturer.

Dc. Same as Ab.

11.63 Operating current

The system shall operate from the 115-volt 60-cycle lighting supply.

11.64 Wiring

All wiring shall be of the approved type as used for electric light and power wiring and shall meet the requirements of national, state and local electric codes. The size and number of wires shall be as specified by the manufacturer of the clock system.

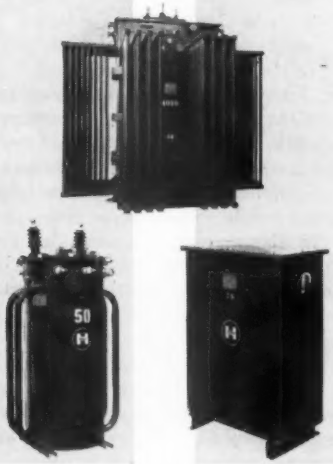
11.7 Program Signal System

Note: In many applications, such as in schools, it is customary to have both a clock and program signal system, whereas other applications, such as a small factory may require only a program signal system. Some manufacturers build the program control and the clock control into the same unit when the two systems are required; whereas other manufacturers use separate physical units for the two functions. Various designs and sizes (according to the number of different program schedules required) of program instruments are available. The specifying agent should determine the number of different program schedules actually required for the specific installation at hand as cost of the program instruments varies accordingly. For example, a small factory or primary school would normally only require the program instrument to have one program circuit since all signals of the building would sound on the same schedule, whereas a large office build-

(*Continued on page* 278)

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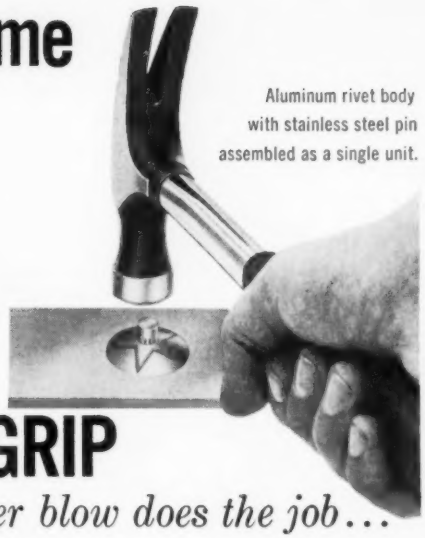


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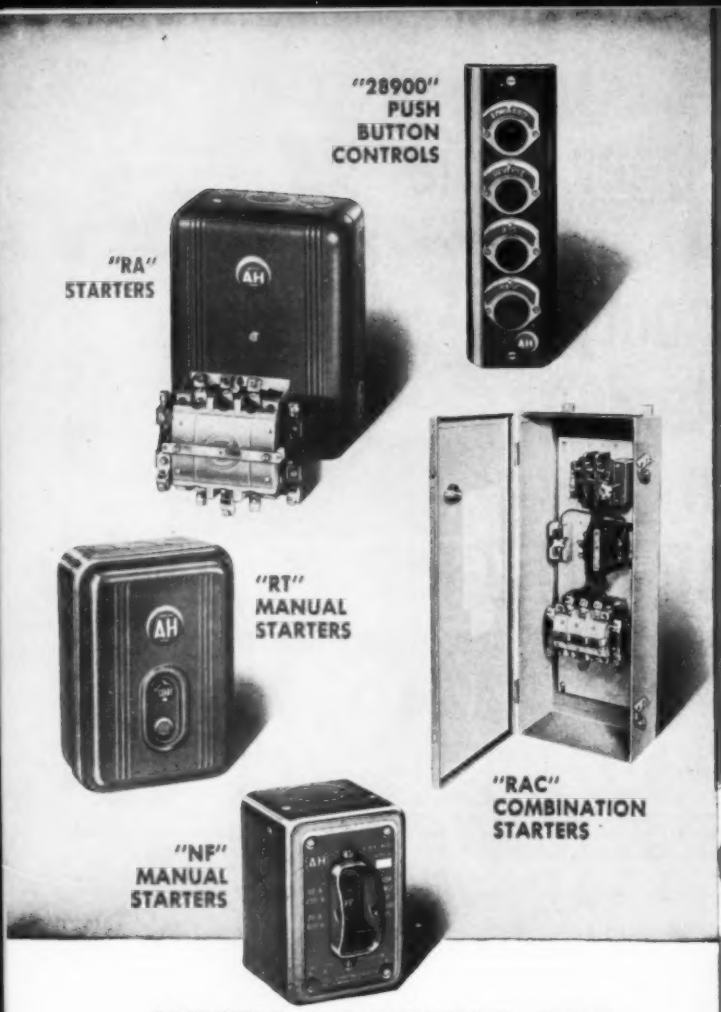


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11.0 Signal

ing or high school might require four, six or more, different program schedules. Program instruments vary by manufacturer as to the method in which the program schedule is set up and changed—some complicated, requiring the services of the manufacturer; others simpler which can be done by the owner. The specifying agent should, therefore, examine the various types available and select the type(s) and/or manufacturer(s) which he feels provides ease in changing the program schedule since many applications, such as schools require occasional changes in schedules. The following specifications do not attempt to describe the construction and design of all the available makes, they merely outline basic features and operation. When both a clock and program signal system are required, it should be determined that the manufacturer of the clock system (i. e., A, B, C or D) to be specified has available the type of program instrument desired or vice versa, as the same manufacturer should furnish equipment for both systems since they should have one central control.

11.71 General

Furnish and install a (trade name and/or number) program instrument as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be installed in accordance with the manufacturer's specifications and left in first-class operating condition according to the specifications.

11.72 Operation

The program instrument shall automatically control the operation of a group or groups of signals according to the desired program schedule. It shall be able to operate the signals, any minute during the 24-hour day, 7-day week. The program schedule may be set so that the signals connected to each circuit are independently omitted on any day or days during the week. (Example: Most installations do not require the signals be operated on Saturday or Sunday.) Provisions shall be provided for the manual operation and for cutoff of the signals wired on the same circuit for special day schedules without disturbing the program settings or the running of the program instrument. Means shall be provided for adjusting

(Continued on part 279)

the duration of sounding the signals. Program instruments having a capacity of more than one circuit (each group of signals which are to operate on an individual program schedule are wired to a separate circuit terminating at the program instrument) shall provide two adjustable signal durations so that the exterior signals which are wired on one circuit may be sounded for a longer duration than the interior signals which are wired to the other circuits. When the program instrument is installed with a clock system, the same central control equipment shall be used to control both the clock system and the program instrument.

11.73 Equipment

A. Install where shown a flush (or surface) mounted program instrument for automatically operating signals according to a predetermined schedule of minute intervals of a 24-hour day, 7-day week. The instruments shall have a capacity of ———— circuits, (specify the number of circuits which is determined by the number of groups of signals wired independently to the program instrument so that each group may operate on its own schedule) each circuit to have its own program schedule. The instrument shall accommodate a schedule that eliminates the operation of the signals, independently by circuit, on any day or days during the week, for use when required. Manufacturer's installation instructions should be carefully followed in adjusting program controls.

The instrument shall have a cutoff switch and pushbutton for the manual operation of the signals connected to each circuit. Operation of these switches shall not interfere with the time setting and running of the instrument. Adjustable time duration contacts shall be provided so that the owner can set the desired duration the signals are to be actuated. The duration shall be adjustable for a minimum of 3 to 10 seconds. Program instruments having capacity of two or more circuits shall have two sets of duration contacts, one being connected to one circuit and the other to the balance of the circuits to be controlled by the instrument.

The program instrument shall include the necessary relays to operate the signals of the system. Should the current requirements of the signals exceed the capacity of the relay in the instrument, additional relays to carry this load shall be provided by the manufacturer. These may be

(*Continued on page* 281)



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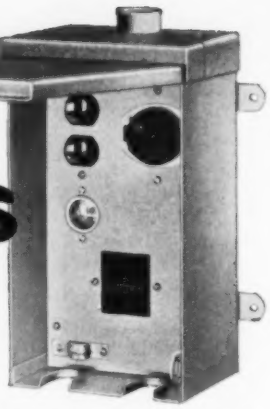
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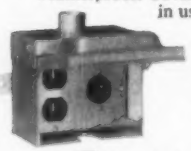
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- Farm and Ranch use
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MODEL "50-15" solves power problems for Mobile Home Parks because it receives a wide variety of plugs. Offers a 50 amp. 250 volt 3-wire power receptacle, and a 15 amp. grounded duplex receptacle. Protected with two 50 amp. circuit breakers and fuse. Ample space for plug-in adapters when needed. Top hub and bottom knockouts facilitate overhead or underground connections. Completely weatherproof. Cover closes and can be padlocked when in use. Cords hang through rounded cord slots.



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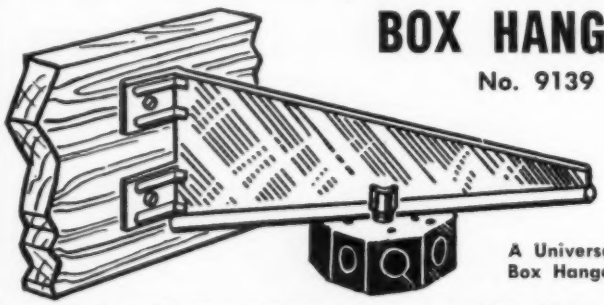
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No. 9139



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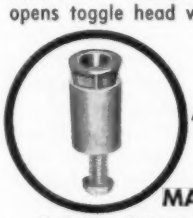
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YORK, PA. DEPT. EC-5

11.0 Signal

separately mounted from the program instrument.

The instrument shall be so designed that the program may be easily changed by the owner.

The instrument shall be housed in a steel cabinet with hinged cover, complete with lock and key.

Install where shown, a vibrating bell (4-, 6-, or 10-in.) or horn (grille or projector type) or buzzer and wire to program instrument.

Signals installed outside shall be furnished in weather-proof construction complete with aluminum protective hood.

All signals which are to operate on the same program schedule shall be wired on the same circuit to the associated circuit terminals in the program instrument.

11.74 Operating Current

The system shall operate from the 115-volt, 60-cycle lighting supply.

11.75 Wiring

All wiring shall be of the approved type and shall meet the requirements of national, state and local electric codes. The size and number of wires shall be as specified by the manufacturer of the system.

11.8 Nurses' Calling System

A. Visual system.

B. Audio-visual, reset only at bedside, system.

C. Audio-visual, reset at nurses' station, system.

D. Psychiatric ward—alarm system.

11.81 General

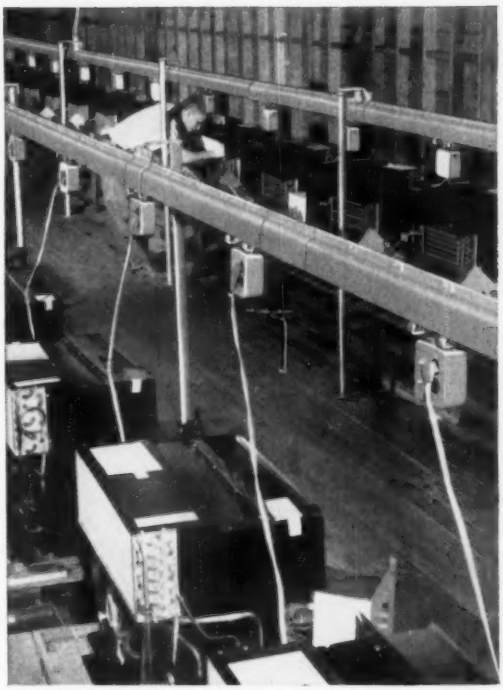
Furnish and install (trade name and/or number, nurses' calling system as manufactured by—name of manufacturer) and described in these specifications and indicated on wiring plans. The system shall be wired and installed in accordance with manufacturer's specifications and left in first-class operating condition.

11.82 Operation

A. Visual System.

When a patient requires assistance, he shall press a locking button which shall light corridor dome lamp, utility dome lamp and associated room light in annunciator at nurses' station and momentarily sound buzzer signal at utility and nurses' stations. The buzzer signal may be repeated by the patient by pressing his calling button.

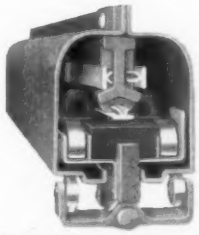
(*Continued on page* 283)



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Flexible Feedrail systems, in capacities from 60 to 500 amperes, provide convenient movable power sources for cranes and hoists; production, conveyor assembly, and moving test lines; portable and machine tools; cutting and sewing rooms; business machines; lighting; and motor control.

**Survey was conducted among 2,036 plant engineers by an impartial organization and printed in a leading trade magazine. Write for free copy of entire survey.*



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THE CALVERT COMPANY
19851 INGERSOLL DRIVE
ROCKY RIVER 16, OHIO

11.0 Signal

The patients' stations in wards shall operate similarly to above, except a pilot lamp shall be lit in the patients' station to identify to the nurse when entering the room, which station initiated the call. All lamp signals shall remain lit until the operated button is reset. The buzzers in the utility stations and nurses' station shall be equipped with cutoff switches to silence the buzzer during night duty, if desired. Accidental removal of the patients' calling button cord set shall give the light signals as though the patient had pressed his button, except that the buzzers in the system shall sound continuously. These signals may be cancelled by the nurse by a device in the receptacle of the patients' calling station, in event the calling button cord set is intentionally removed from the wall. The patients' station shall be automatically restored to an operating condition when the calling button cord set is replaced into the patients' station. Calls from toilets are initiated by the patient pressing a wall button which shall light a red lamp in the corridor domes, utility stations, and nurses' station annunciator and cause the buzzers in the system to sound continuously.

Calls from operating, delivery rooms, etc, containing combustible anesthetics agents, shall originate from foot-operated explosion-proof stations in these rooms and will give the same indications as described for toilet stations.

B. Audio visual system, reset only at bedside, system.

When a patient requires assistance, he shall press a locking button which shall light corridor dome lamp, utility dome light and associated room lamp in nurses' master station and momentarily sound buzzer signal at utility and nurses' stations. The buzzer signal may be repeated by the patient by pressing his calling button. The patients' stations in wards shall operate similarly to above, except a pilot lamp shall be lit in the patients' station to identify to the nurse when answering the call from the corridor, which station initiated the coil. All lamp signals shall remain lit until the operated button is reset. The buzzers in the system shall be equipped with cutoff switches to silence the buzzer during night duty if desired. Accidental removal of the patients' calling button cord set shall give the same light signals as though the patient had pressed

(*Continued on page* 285)



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RS-3

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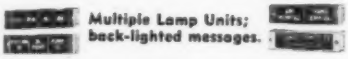


T2MC (5/8" d.)
(Slide Base Bulb)

Lamp units with brilliantly illuminated message eliminate a separate nameplate. One or many different messages of this modern indicating lamp custom-engraved to your specifications.



170 (2 1/8" d.)
(Bayonet or Screw Bulb)



Multiple Lamp Units; back-lighted messages.



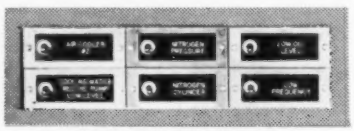
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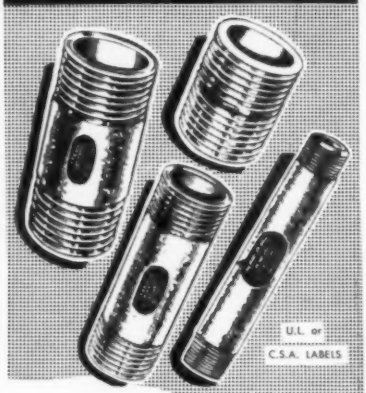
2025-F (31/32" x 11/16")
2026-F (1 13/32" x 31/32")
(Bayonet Bulb; also Matching Push Button)



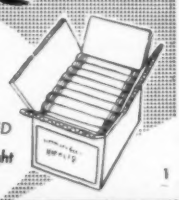
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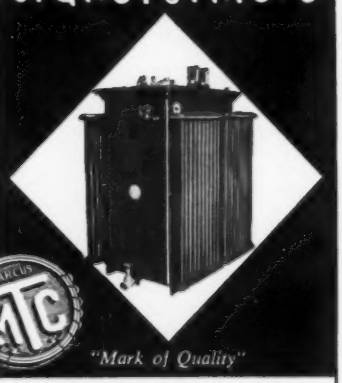
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11.0 Signal

his button, except that the buzzers in the system shall sound continuously. These signals may be cancelled by the nurse by a device in the receptacle of the patients' calling station in event the calling button cord set is intentionally removed from the wall. The patients' station shall be automatically restored to an operating condition when the calling button cord set is replaced into the patients' stations. Calls from toilets are initiated by the patient pressing a wall button which shall light a red lamp in the corridor domes, utility stations and nurses' master station and cause the buzzers in the system to sound continuously. The nurse shall be able to establish two-way conversation with the patient after throwing a key or pressing a button associated with the lit room lamp on the master station and using the handset of the master station. The patient may carry on the conversation from his normal position in bed through the speaker-microphone of his station. When the conversation is completed, the nurse may request the patient to reset his button if a trip to the bedside is not necessary. (NOTE: The following should be specified if the hospital has the requirement that the patients in private rooms shall be able to prevent the nurse at the master station to listen-in or monitor his station without a call having been initiated by the patient.)

It shall be possible for the patients in private rooms to obtain privacy from the nurse monitoring his station by a switch on the patients' room station. Throwing this switch to the "Privacy" position will prevent the nurse from listening to the patient's station, but shall not prevent the nurse from speaking to the patient. (This feature is desirable so that the nurse may request the patient to throw his privacy switch back to normal so that a call placed by patient may be heard.)

Calls from operating, delivery rooms, etc., containing combustible anesthetic agents, shall originate from foot-operated explosion-proof stations in these rooms and shall give the same indications as described for toilet stations.

Failure of the amplifier or audio circuits of the system shall not prevent the lamps of the system from registering.

C. Audio-Visual, reset at nurses' station system.

When a patient requires assistance, he shall press a pendant-type momen-

(*Continued on page* 286)

Meeting Your Rigid Specifications...

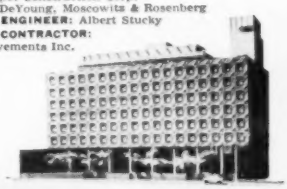
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ELECTRICAL CONTRACTOR: Nager Electric Co., Inc.



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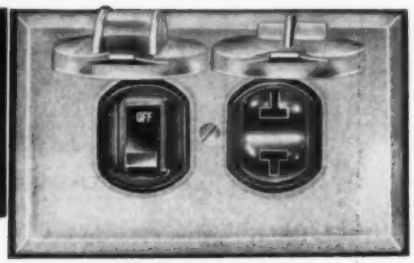
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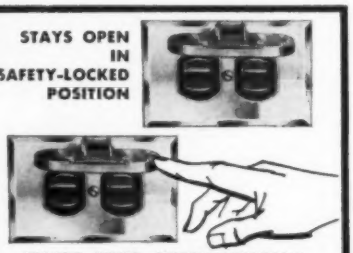


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STAY OPEN
SNAP-COVER
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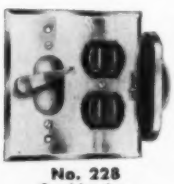
Bell—The *Complete* Line—The *Only* Line with SAF-T-LOK SNAP-COVERS OR SCREW COVERS in 1 or 2-gang Combinations.



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11.0 Signal

tary call button which shall light corridor dome light, utility dome lamp and associated pilot lamp on master station and momentarily sound buzzer signal at utility and nurses' station. Nurse shall establish communication with patient by throwing the key switch or pressing button associated with the lighted pilot lamp on the master station and as soon as the nurse starts a conversation with the patient, all lamps shall be automatically reset. The call may also be reset at the bedside by pressing the reset button in the patients' station. The nurse may monitor any room by merely throwing that room key on the master station. Patients' privacy, when required, may be obtained, depending upon the type of system specified as follows: (Specify one type of privacy).

TYPE 1. By a green pilot lamp on the patients' station being lit whenever nurse monitors that station.

TYPE 2. By a privacy switch on the patients' station which when thrown, will prevent nurse from listening to room, but will allow nurse to talk to patient. This is desirable so that nurse may request patient to restore privacy switch to normal so that a call placed by patient may be answered.

All cord-jacks shall be equipped with safety feature which automatically lights all lights and continuously sounds all buzzers when cord is accidentally removed from jack. If cord is to be removed for cleaning or servicing, a plug shall be inserted into the jack of the patients' station.

Wall-type locking button stations in toilets and baths shall light red lamps in corridor, utility and master station and sound all buzzers continuously until reset. Foot-operated explosion-proof station shall give same operation as toilet stations in operating and delivery rooms.

Failure of the amplifier or audio circuits shall not prevent the lamps of the system from registering.

D. Psychiatric ward alarm system.

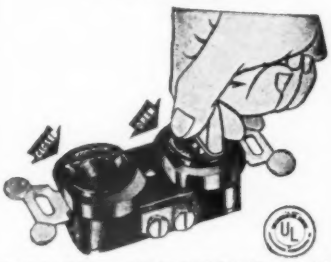
Before entering a room, the nurse operates key switch at room entrance station which shall light the white lamp in corridor dome and white room indication in nurses' station annunciator and energize the calling button in the room. Should nurse need assistance when in the room, she touches the calling button which shall light the red lamp in corridor dome and red room

(*Continued on page* 288)

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PATENTED SELF-CLOSING CAP positively prevents SHOCKS . . . BURNS . . . SHORT CIRCUITS! NO-SHOK automatically prevents insertion of hairpins, wires or other metal objects — protects children against tragic electrical accidents. Install NO-SHOK — an extra selling feature for safety-conscious home buyers!

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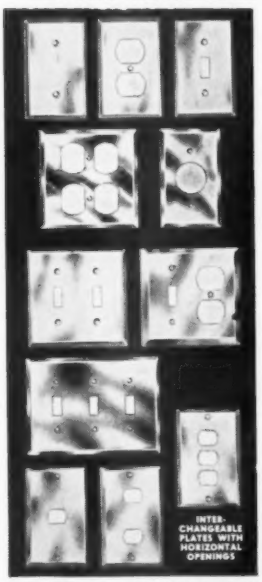
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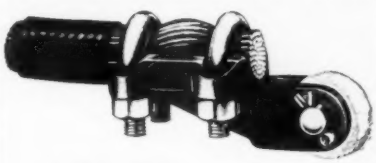
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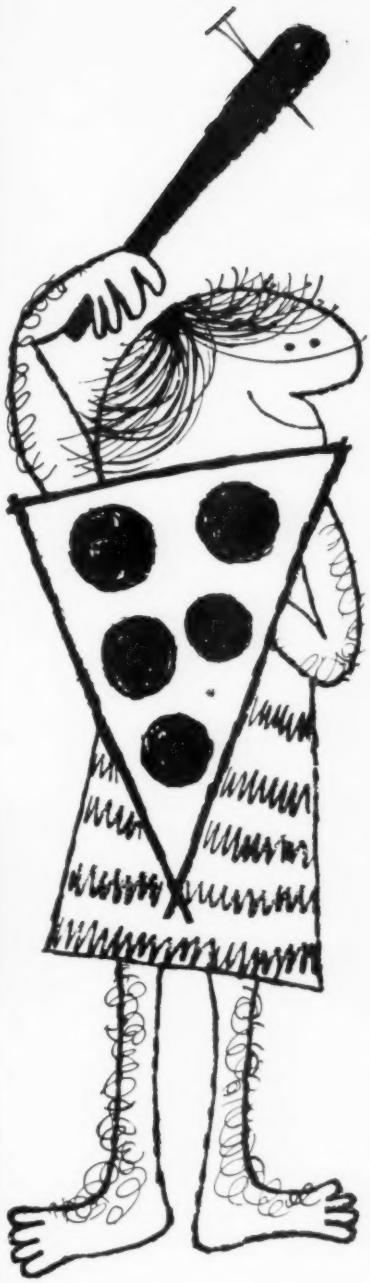
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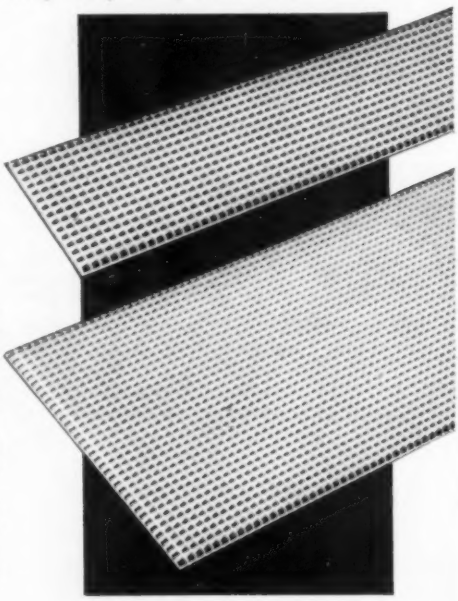
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11.0 Signal

indication in nurses' station annunciator and sound the alarm bell in the annunciator and all other alarm bells as shown on the plans. These lamp and audible signals cannot be cancelled until the room entrance station is reset by key.

11.83 Equipment

Aa. Install in all private rooms as shown on the plans, a nurses' calling station consisting of a receptacle for the calling cord mounted on a single gang subplate to which there shall be installed a stainless steel wall plate. The station shall be complete with detachable calling cord set, consisting of plug, 6-ft 5-conductor cord and durable locking button with reset feature. This cord set shall be interchangeable with the double cord sets specified for semi-private rooms (Ab) as to mounting in the station receptacle.

Ab. Install in all semi-private rooms as shown on the plans, mounted between the beds a nurses' calling station of the same type as specified for private rooms (Aa), except a double cord set shall be furnished. This double cord set shall be interchangeable with the single cord sets as to mounting in the station receptacle.

Ac. Install in all wards or rooms having more than one pair of beds, as shown on the plans, nurses' calling stations similar to those specified for semi-private rooms (Ab), except that the station shall also include a pilot lamp.

Ad. Install in all toilets and bathrooms as shown on the plans a (1) wall type locking button (2) pull cord, nurses' calling station mounted on a single gang subplate with stainless steel wall plate.

Ae. Install on each porch or balcony as shown on the plans a nurses' call station similar to that specified for the private rooms (Aa) except that it shall be weatherproof and provided with screw-on cover for the receptacle, rubber gasket between the wall plate and the wall and the cord set shall be 15 ft long.

Af. Install in operating, delivery and other rooms having combustible anesthetic agents, a foot-operated explosion-proof station.

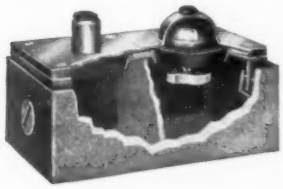
Ag. Install in the corridor over each patient's room or ward as shown on the plans, a dome type corridor station. This station shall consist of a lamp, mounted on a 2-gang subplate and a stainless steel 2-gang plate hav-

(*Continued on page* 290)

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Two Gang Adjustable Floor Box

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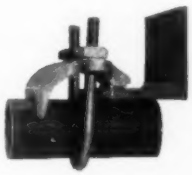




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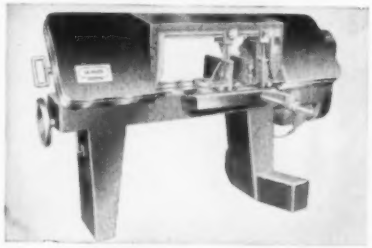


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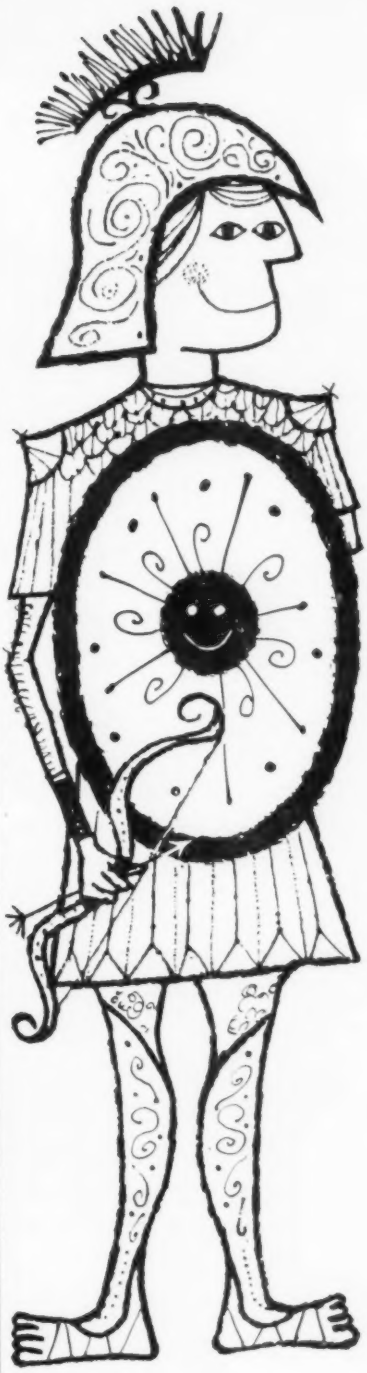
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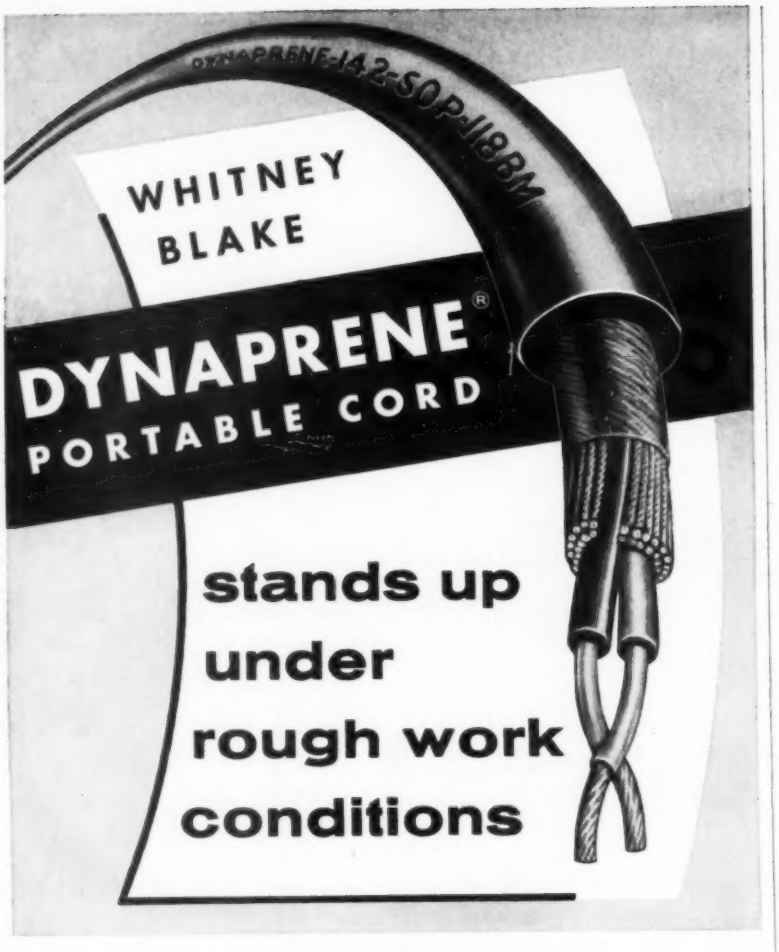
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11.0 Signal

ing mounted thereon a glass or translucent plastic dome hinged and fastened to the plate. For those patients' rooms having toilets the station shall contain a red and white lamp with horizontal barrier between the lamps, under the dome.

Ah. Install in the utility, diet kitchen, duty rooms, etc., as shown on the plans a station consisting of a 3-gang subplate mounted thereon a buzzer with cutoff switch and 2 lamps (1 red, 1 white) and 3-gang stainless plate mounted thereon a hinged glass or translucent plastic dome having horizontal barrier between the two lamps.

Ai. Install at the nurses' station on each floor as shown on the plans, a flush lamp annunciator with metal trim and hinged door. The annunciator shall contain the necessary number of room indications to receive the calls from all rooms (one per room) having calling stations which shall indicate the room number by a white lamp behind a translucent marking plate. Calls from the toilets shall be indicated by a red lamp behind the translucent marking plate. These plates shall be easily removable for lamp replacement. The annunciator shall contain a buzzer with cutoff switch, accessible from the front.

Aj. All lamps and signals in the system shall be 24-volt secondary of a heavy duty signaling transformer as indicated on the plans. This transformer shall have sufficient capacity to light one-fourth of all the lamps in the system on that floor. There shall be at least one transformer of this type on each floor. The primaries of all of these transformers shall be connected to the 115-volt, 60-cycle lighting supply.

Ba. Install in all private rooms as shown on the plans, a nurses' calling station having subplate construction for mounting on multi-gang outlet boxes. Mounted on the subplates, there shall be a receptacle for the calling cord and a sensitive microphone-speaker protected by a metal grille. (NOTE: If the privacy feature is required, insert the following. A privacy switch shall be included on the station so arranged that when thrown to the "Privacy" position, it shall prevent the master station from listening to this station; however, this shall not prevent the nurse at the master station from speaking to the patient.) The faceplate shall be stainless steel. The station shall be complete with detachable call-

When Specs say,

"TV OUTLETS"

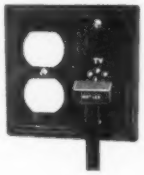
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11.0 Signal

ing cord set, consisting of plug, 6-ft 5-conductor calling cord and durable locking button with reset feature.

Bb. Install in all semi-private rooms, as shown on the plans mounted between the beds, a nurses' calling station of the same type as specified for private rooms (Ba), except a double cord set shall be furnished.

Bc. Install in all wards or rooms having more than one pair of beds as shown on the plans, nurses' calling stations of the same type as those specified for semi-private rooms (Bb), except that the station shall also include a pilot lamp.

Bd. (same as Ad).

Be. (same as Ae).

Bf. (same as Af).

Bg. (same as Ag).

Bh. (same as Ah).

Bi. Install at the nurses' station as shown on the plans, a master station, portable type, having an indicating lamp for each room having a speaker-microphone station (Bd, Bb, Bc) and associated keys or buttons. The master station shall be complete with a handset, supervisory lamp, emergency lamp, buzzer with cutoff switch and switch on front for varying the sensitivity of the bedside speaker, amplifier with cord and plug. A flush (or surface) terminal box shall be installed as shown on the plans to accommodate the system wiring to the calling stations and shall be connected to the master station by flexible cables.

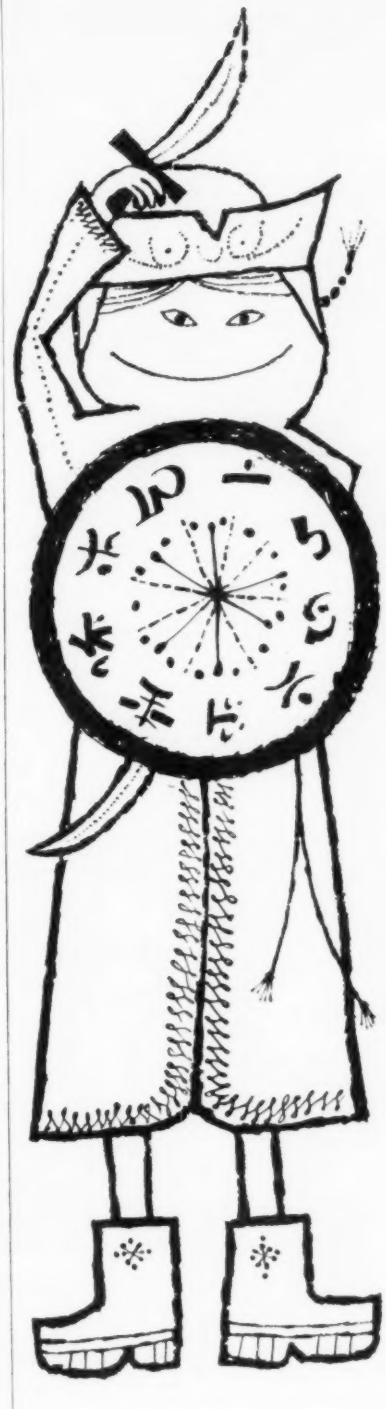
Bj. (Same as Aj).

Ca. Install in all private rooms a nurses' calling station as shown on the plans having subplate construction. Mounted on the subplate there shall be a receptacle for the calling cord, a sensitive microphone-speaker, relay with protective cover, reset button and terminal strip. NOTE: If Type 1 privacy is specified in operation, insert the following, "and green pilot lamp." If Type 2 privacy is specified insert the following, "and privacy switch.") The faceplate shall be stainless steel. The station shall be complete with cord set, consisting of momentary pushbutton, 6-ft of cord and plug.

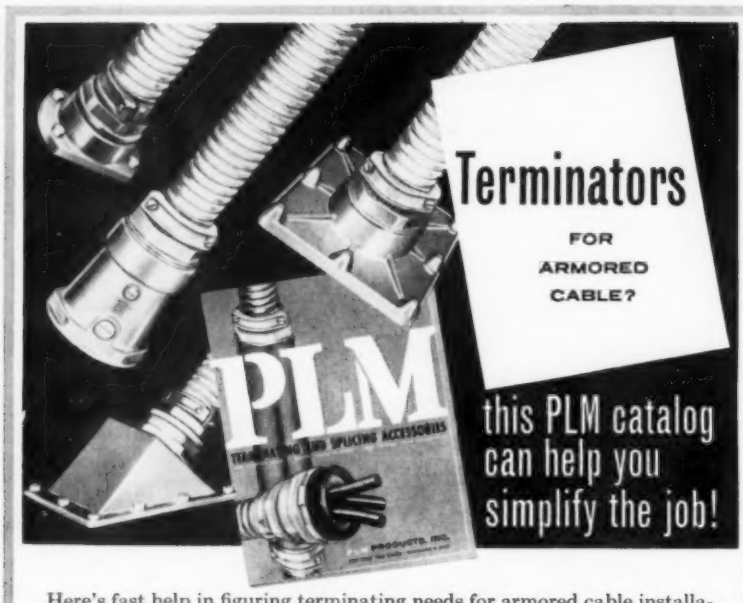
Cb. Install in all semi-private rooms, a nurses' calling station mounted between the beds as shown on the plans a nurses' calling station which is the same type as those installed in private rooms (Ca) except it shall have two calling cords.

Cc. Install in all wards or rooms having more than one pair of beds, as

(*Continued on page* 293)



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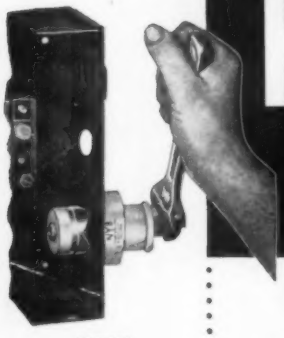
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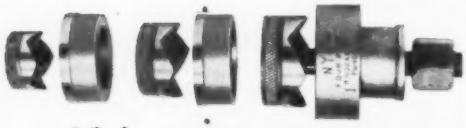
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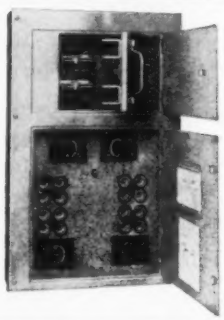
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11.0 Signal

shown on the plans, nurses' calling stations of the same type as those specified for semi-private rooms (Cb) except that the station shall also include a pilot lamp.

Cd. (same as Ad)
Ce. (same as Ae)
Cf. (same as Af)
Cg. (same as Ag)
Ch. (same as Ah)
Ci. (same as Bi)
Cj. (Same as Aj)

Da. Install in corridor outside each room as shown on the plans a room entrance station, including, cylinder key switch, relay and terminal strip with stainless steel wall plate. All fastening screws shall be tamperproof type.

Dc. (Same as Ag with red and white lamps).

Dd. (Same as Ai, having red and white lamps under each marking plate and with bell in lieu of buzzer and without cutoff switch.)

De. Install in the corridors and at places shown on the plans a 10-in. vibrating alarm bell in flush box with grille front.

Df. (same as Aj).

11.84 Wiring

All wiring shall be of the approved type and shall be installed in accordance with the wiring diagram and instructions of the manufacturer.

11.9 Television Antenna System

11.91 General

Furnish and install a (trade name and/or number) television antenna system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left completely equipped and in first class operating condition.

A. Television antenna system, amplified: Install custom built television antennas for channels (mention channel numbers) as desired. There shall be installed six antenna on each mast with coaxial cable to each apartment, each antenna shall be designed to match the coaxial cable transmission line. The quality of the television signal for each channel received shall be equal or superior to that which could be obtained by the use of an individual antenna for each outlet. Wiring from each antenna to the amplifier

(*Continued on page* 294)



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CONTRACTORS

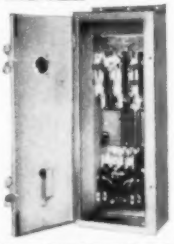
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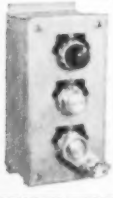


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11.0 Signal

units shall be in a coaxial cable as recommended by the manufacturer. The system shall be complete with television set outlets and ground wire. The antennas shall be properly supported and braced. They shall clear the roof by at least 15 ft and be arranged so that there will be no interference between antennas. Outlets shall be installed at locations shown on plans. Grounding of the support shall be made to the nearest cold water pipe.

11.92 Equipment

Aa. Install in each suite where shown a television set outlet on single gang metal (or plastic) plate for connecting the set to the antenna.

The outlet device for television shall be designed to completely isolate all apartments from each other, so that a short circuit, open circuit or a defective television receiver connected to any receiver outlet, shall not affect the operation of any other television receiver connected to the system. The receiver outlet shall have a compensating attenuation network, so that the signal level in the last apartment on the coaxial transmission line will be approximately the same as that of the first apartment on the transmission line. The signal level at the outlets shall not be less than 1,000 micro-volts on the various television channels.

Ab. Install a multi-channel amplifier where shown in ventilated steel cabinet. This shall consist of a heavy duty power supply unit, a separate amplifier for each television channel and a separate amplifier for the FM channel. Provision shall be incorporated in the amplifier so that additional television channels may be installed if necessary in the future. The amplifier shall be designed for continuous duty and shall consume not more than 300 watts of power when operated on a 125-volt 60-cycle line. A filter shall be incorporated to eliminate all FM and diathermy interference from the television channels.

Ac. Distribution equipment and line splitters for supplying branch feeders from the main trunk line may be either electronic or passive. Each feeder line shall be completely isolated from any other feeder line. They shall be completely wired in suitable steel cabinet and equipped with coaxial receptacles and plugs for connection of incoming and outgoing cables. All wiring from amplifiers to distribution and from distribution equipment to

outlets shall be coaxial transmission cable.

Ad. Install where shown on roof necessary number of antennas to provide service on all television channels specified. These shall be of the directional type and connected to coaxial cable. Where received signals at the antenna are weak, high gain, low noise figure pre-amplifiers shall be used to increase the signal levels to the rated input of the master amplifier.

11.93 Operating current

All power outlets for sets shall be connected to the lighting system in the suites and shall not be combined in same outlet box with the television set outlet. Amplifiers shall be connected to separate circuit from nearest lighting panel supplying current to the building proper.

11.94 Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The lead-in or down-lead wires for television shall be coaxial cable of the size and type as recommended by the manufacturer of the antenna system. Wires for ground connection shall be as recommended by the manufacturer of the antenna system. Coaxial cable shall be run in continuous lengths from the antenna to the amplifier and distribution units. This cable shall be connected to the individual television outlets by means of solderless coaxial connectors.



GUESTS at the March meeting of the Cook County Electrical Contractors Association were these officers representing the Indianapolis Electrical Contractors Association. (Left to right) George Hayes, B & H Electric Co., vice-president; J. E. Lucas, Lucas Electric Co., treasurer; Guy B. Moore, J. & E. Electric Service, Inc., president; and Jim Krukemeir, Krukemeier Electric Service, past-president. The dinner meeting was also highlighted by an interesting and informative program presented by representatives of the Square D Co. who talked on "Motor Control Circuits"; and a discussion on "Job Tools and Their Use" by EC&M's August Eckel.

B

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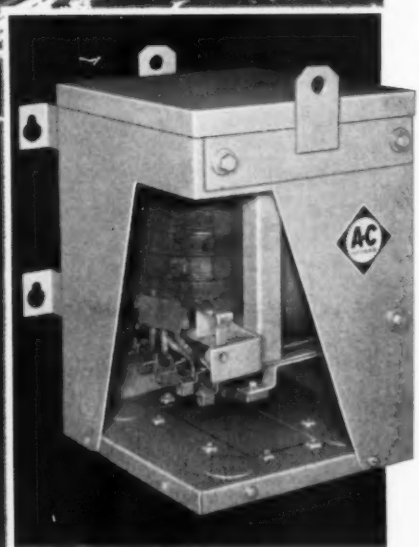
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Cutaway model. Transformers are available in single-phase and three-phase designs, ranging from 3 to 75 kva, 600 volts or less.

IT isn't likely that utilities and industrial users subject dry-type transformers to the punishment the U. S. Navy expects its equipment to withstand. Yet, Allis-Chalmers gives you the same, extra-dependable dry-type transformers in "industrial-type" enclosures that the Navy installs in supercarriers, guided-missile destroyers and mine sweepers.

Allis-Chalmers totally enclosed dry-type transformers can save you as much as 20% on initial cost in place of an oil-filled unit. They are more economical to operate and can actually increase production. These units can be located outdoors, they're weatherproof—or indoors in dusty, lint-filled or moist atmospheres. They are quickly and easily mounted on walls, posts or machinery. Maintenance is virtually eliminated because there is no cooling liquid to change or filter — the coil is given maximum protection with high temperature insulating materials consisting of Fiberglas, asbestos based materials and silicone varnish.

For complete information, call your nearby A-C representative or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-5637

A-C ALLIS-CHALMERS

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Product News



Highway Luminaires (1)

A series of completely new design luminaires for both mercury and fluorescent lamps include 2-lamp luminaires designed for installation parallel with the roadway, 2-lamp, 4-lamp, and 6-lamp luminaires for installation perpendicular (across) to the roadway, a new 400-watt mercury luminaire equipped with shatterproof acrylic refractor, and a new 700-watt mercury luminaire complete with built-in ballast. Also announced at the same time was a redesigned and improved line of general purpose and heavy duty floodlights to provide easier, more economical installation.

A radical new concept using fluorescent luminaires is called "Tee-Lighting". Two 2-lamp flanking units are installed end-to-end and parallel to the curb. A third luminaire is extended over the pavement in the conventional manner.

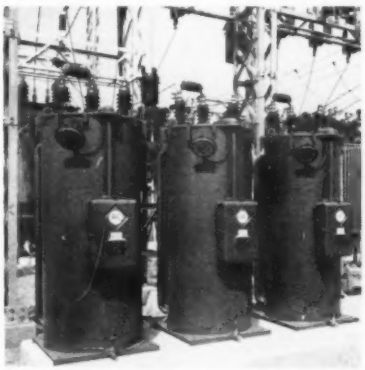
The 6-lamp luminaire in the fluorescent "Tee-Lighting" series (Form 606C) is believed to be the world's most powerful and most sophisticated fluorescent street and highway lighting luminaire currently available. Using six 6-ft "Power Groove" lamps, it generates 55,800 lumens of light.

General Electric Co., Outdoor Lighting Dept., Hendersonville, N. C.

Fluorescent Fixture (2)

An all-steel surface mounted, luminous, indirect fluorescent fixture called the "SMI" series, meaning surface mounted indirect. By an arrangement of reflecting vanes and reflector surfaces, the lamps are shielded below the horizontal plane, yet the light illuminates the visible surfaces. The light is directed to the ceiling with a wide spread. Series is 6 in. deep and available in 48-in. RS, 48-, 72-, and 96-in. 430 ma slimline, and 48-, 72-, and 96-in. 800 ma high output.

Leadlight Fixture Co., 800-100th Ave., Oakland, Calif.



Distribution Regulators (3)

Extra kva capacity by increasing the "Vari-Amp" rating of the distribution regulators from 400 amps to 600 amps, has been announced. The "Vari-Amp" rating of all distribution regulators will be 160% of rated current with a maximum of 600 amps. A 25 kva, 2500-volt regulator rated 100 amps is capable of carrying 160 amps at 5% regulation; 100 kva, 2500-volt regulator rated 400 amps is capable of carrying 600 amps at 5% regulation.

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Insulated Bushing (4)

New line of black butyrate insulating bushings for use with rigid electrical conduit. Bushings are of ribbed design and engineered to withstand heavy impact. Deep threads permit high torque pressures without stripping, while an extra-heavy bottom flange provides added strength. Twelve raised ribs assure easy finger tightening and final screw or channel lock setting. Available in a complete range of 12 sizes from ½ to 6 in.

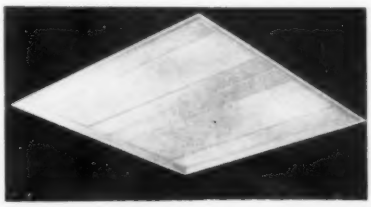
National Electric Products Corp., 2 Gateway Center, Pittsburgh 22, Pa.



Transformers (5)

New line of 3-phase dry type power and lighting transformers have sound levels within NEMA standards. Outputs range from 6 to 2000 kva. Standard sizes available in 600-volt, 5 kv, 8.66 kv, and 15 kv insulation classes. Well ventilated steel cases protect the transformer externally while rigid blocking of coils and varnish impregnation of the core and coil withstand internal stresses. Wiring compartments are accessible through removable side panels and covers. Primary and secondary leads are marked and nameplate carries simplified wiring diagram. Bulletin 200 available.

Hevi-Duty Electric Co., Milwaukee 1, Wis.

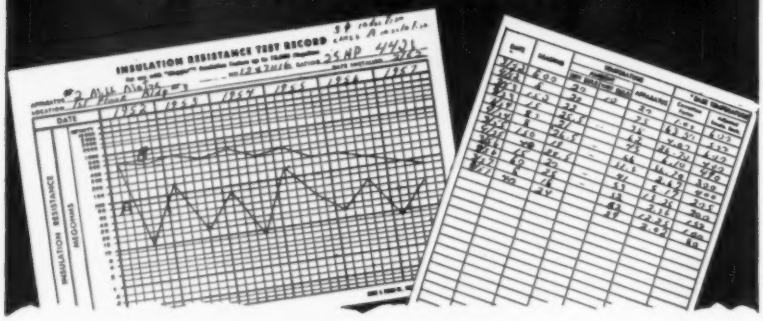


Square Fluorescent (6)

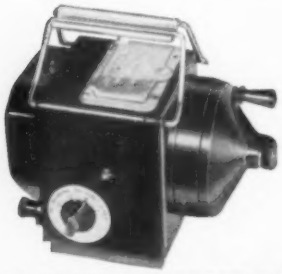
The new "4 Square" is a large recessed lighting element of shallow dimensions; measures 49½ ins. by 52½ ins. by 4 ins. deep. Is easily installed in plaster or acoustical ceilings. Special splay provides a blend between luminous enclosure and surrounding ceiling area. Available in plastic Cleartex, Daytex, and Crestex. May be equipped with four, six, or eight 4-ft rapid start lamps.

Day-Brite Lighting Inc., 6260 N. Broadway, St. Louis 15, Mo.

"A STITCH IN TIME" SAVES DOWNTIME



In other words, a "test in time" often avoids a costly machine outage, production loss and serious maintenance expense. The Test Record shown here is an example of how periodic measuring with a Megger® Insulation Resistance Tester gives you advance warning of impending trouble on an electric motor. This motor was repaired on a planned outage rather than under emergency conditions. Other dependable Biddle testing instruments are equally useful to detect trouble before it develops.



MEG® TYPE OF MEGGER INSULATION RESISTANCE TESTER— Available hand-operated, rectifier operated, or with a separate rectifier. Ranges up to 2000 megohms and 1000 volts d-c in all three models. BULLETIN 21-45-ECM



SPEED MEASURING INSTRUMENTS — Frahm®, Jagabi®, Dr. Horn, Metron, Jones Tachometers, Jagabi Speed Indicator and Jagabi Tachoscope. There's a Biddle tachometer to suit every maintenance need—to check speeds accurately for load, friction, power transmission and lubrication. BULLETIN 35-ECM



MEGGER GROUND TESTER measures the resistance of earth to ground connections simply, easily and accurately, and thereby helps to determine whether such connections will perform the services for which they were designed & installed. BULLETIN 25-ECM

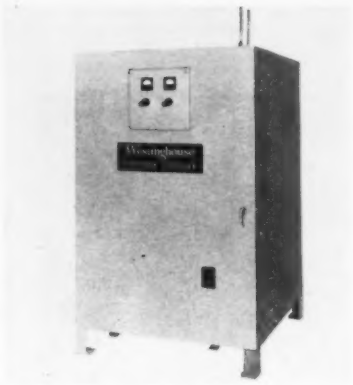


MEGGER LOW RESISTANCE OHMMETER — Battery or rectifier operated. Four ranges 0-1000 microhms down to 0 to 1 ohm. New clamp type test leads 18 ft. long enable one man to make tests. BULLETIN 24-46-ECM

... serving your industry since 1895 B-505

JAMES G. BIDDLE CO.

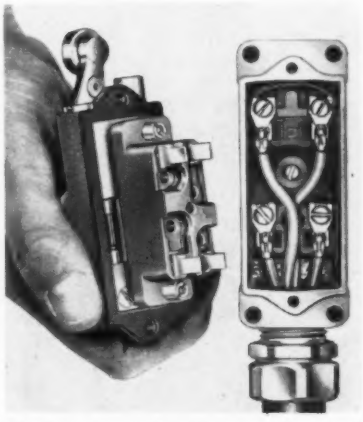
Electrical Testing Instruments • Speed Measuring Instruments
Laboratory & Scientific Equipment
1316 ARCH STREET, PHILADELPHIA 7, PA.



Rectifier Assemblies (7)

New "Semitron" silicon rectifier assemblies rated at 100, 150, 200, and 300 kw are now available. Units provided as regulated or unregulated equipment and include in a single enclosure, complete protective equipment, transformer and rectifier assembly. Regulated units include a saturable reactor and voltage regulator. Advantages include long life, static equipment except for motor-operated fan, and high-speed current limiting fuses in each series group of elements.

Westinghouse Electric Corp., P. O. Box 2099, *Pittsburgh* 30, *Pa.*



Plug-In Limit Switch (8)

New oil-tight plug-in limit switch provides wide flexibility, the base receptacle can be mounted and wired without disassembly. Plug-in switch mechanism is reversible, and can be plugged in with the roller arm at either top or bottom. Receptacle can be mounted on its base or on either side, with conduit opening at top or bottom. Unit provides six different mounting arrangements. Switch action can be reversed by a screwdriver adjustment. Bulletin 9007-AW available.

Square D Co., 4041 *North Richards St., Milwaukee* 12, *Wis.*

Newly designed
Type H Motor Control

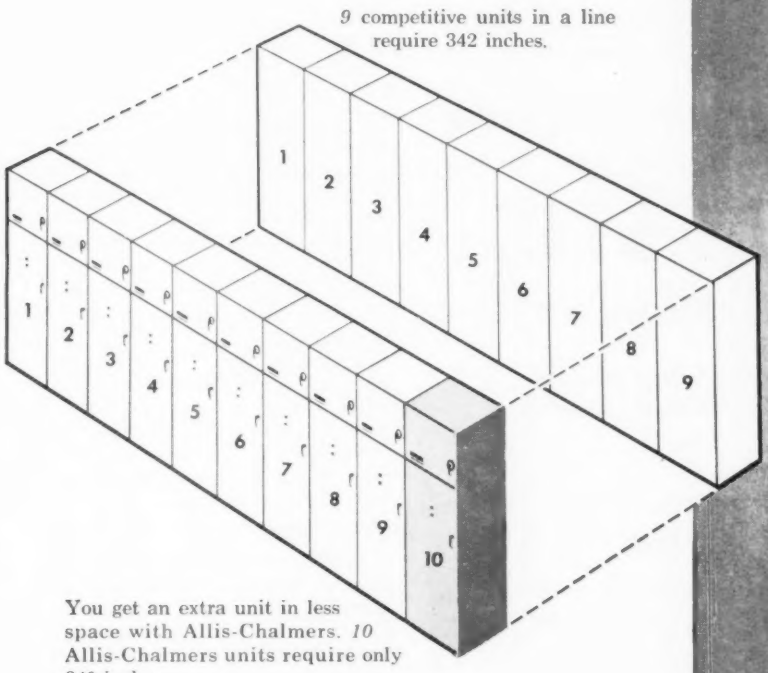


Saves valuable plant space

Newly designed Allis-Chalmers high voltage control units are only 34 inches wide. This means you can put 10 Allis-Chalmers cabinets in less space than required by 9 competitive 38-inch units. In addition, the narrower width means less space required for door swing. Result: You save a total of 2.36 sq ft of floor space per unit. On 10 units, this means a saving of 23.6 sq ft.

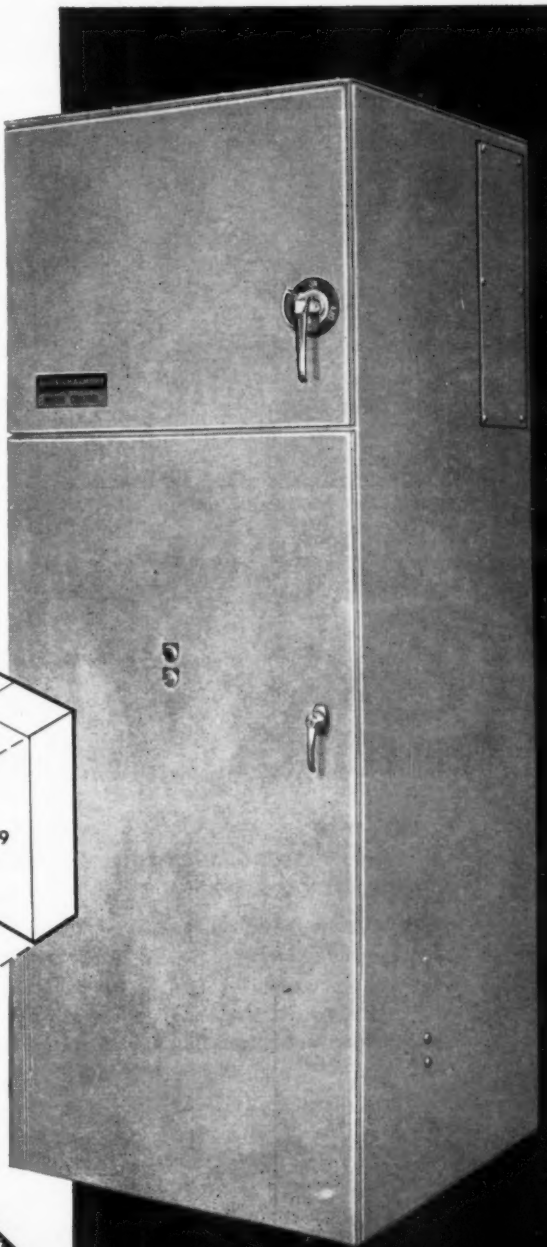
Smaller size is only one of many advantages in this new Allis-Chalmers design. You also get full-front access, more room for optional features, a completely tested unit, and the ultimate in protection for men and machines.

For more information on how this new control design can help you, call your nearest Allis-Chalmers representative, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.



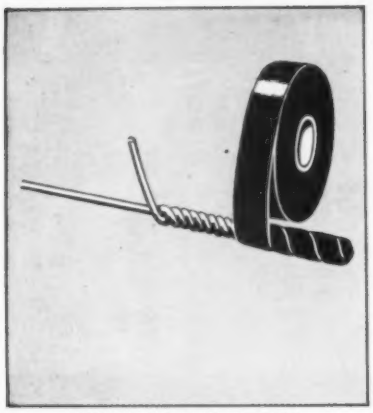
9 competitive units in a line require 342 inches.

You get an extra unit in less space with Allis-Chalmers. *10* Allis-Chalmers units require only 340 inches.

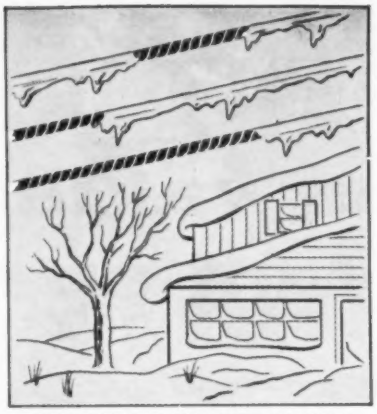


ALLIS-CHALMERS

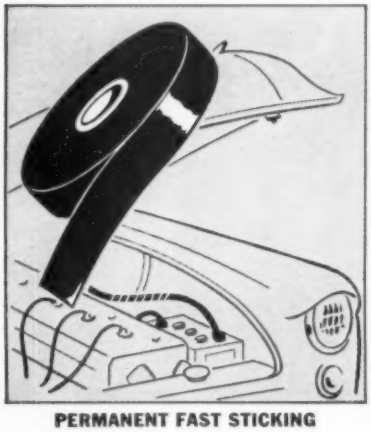
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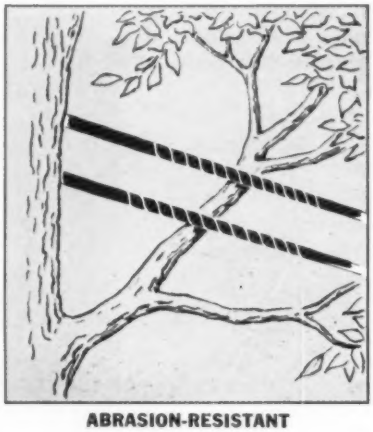
SINGLE-WIND WRAPPING



FLEXIBLE AT LOW TEMPERATURES



PERMANENT FAST STICKING



ABRASION-RESISTANT

OUTSTANDING ONE-WRAP PRIMARY INSULATION

Porter® QUIK-STIK
POLYETHYLENE ELECTRICAL TAPE

- **IDEAL FOR ALL OUTDOOR AND INDOOR, UNDERGROUND OR OVERHEAD WIRING, IN UTILITIES, ELECTRONICS, AIRCRAFT, AUTOMOTIVE, AND GENERAL USE.**
- Permanent strong tack—sticks anywhere!
- Stays flexible from minus 70° F to plus 200° F.
- Dielectric strength tested to 1,000 volts per mil; uniform power factor over wide frequency range.
- Low moisture-permeability, high corona-resistance.
- Resists acids, alkalies, oils, solvents, fungus, bacteria, gases.

GET FULL INFORMATION on new Porter QUIK-STIK polyethylene tape by writing the *Quaker Rubber Division, H. K. Porter Co., Inc.; Philadelphia 24, Pa., or Pittsburg, Calif.*

H. K. PORTER COMPANY, INC.
QUAKER RUBBER DIVISION

Interchangeable Devices (9)

Two new interchangeable devices feature pressure type terminals which take No. 12 or 14 solid wire. Two wire openings for each side of the circuit permit feed-through wiring. Phosphor bronze springs hold wires securely. Bodies are constructed of heavy plastic with molded back covers. No. 1325 outlet features double wipe contacts which grip both sides of plug cap blades. Spring is mounted at the bottom, away from arcing point. Rated 15 amps, 125 volts. No. 1374 flush neon pilot light is equipped with 1/25th watt neon lamp. Dome made of prismatic red Plexiglas. Rated at 125 volts. Both units available in brown or ivory.

Pass & Seymour, Inc., Solvay Station, Syracuse 9, *N. Y.*

Pipe Vise (10)

New No. 25¼-in. to 4½-in. capacity vise features the addition of two jaws, making a total of 5. Five jaws give a positive grip, regardless of pipe or conduit size, up to 4 in. Integral pipe benders are designed to keep pipe from slipping.

The Toledo Pipe Threading Machine Co., 1445 *Summit St., Toledo* 4, *Ohio.*

Fixture Clip (11)

"Snap-On" No. 707 all purpose fixture clip designed to use ½-in-lathing channel for mounting flush, surface or stem fixtures from suspended ceiling framework. Clips snap on the channel at any point and are adjusted from below even after the ceiling tile is in place. By receiving a ⅜-in. nipple or fixture stem, ¼-in. or ⅜-in. rod or bolt, clips are adaptable to any conditions encountered in suspended ceiling work.

Tomic Sales & Engineering Co., Detroit, Mich.

Heat Lamp (12)

Addition of an R-40 red bowl soft glass type heat lamp has been announced. It is designed particularly for indoor use. Lamp can be used outdoors if properly protected against weather and splashing liquids. All three infrared heat lamps in this line are rated at 250-watt usage, have built-in reflectors, fit ordinary light bulb sockets, and operate on household circuits.

Sylvania Lighting Products, 1740 *Broadway, N. Y.* 19, *N. Y.*

Catalogs & Bulletins

(13) REFLECTORS, in complete range of sizes and shapes, are described in new Brochure No. 1093. Basic reflectors up to 16-in. diameter fit standard sockets and include porcelain enamel, standard dome and Angle-Lok lines. 8 pages. Steber Mfg. Co.

(14) CIRCUIT BREAKERS. Complete information on use of current-limiting Cordon breakers for short-circuit protection on low-voltage systems is given in new 20-page bulletin 5043-A. I-T-E Circuit Breaker Co.

(15) PAGING SYSTEMS. Revised catalog, 24 pages, covers full line of coded paging systems as well as signaling devices, bells, chimes, air whistles and electric horns. The Autocall Co.

(16) LIGHTING IDEAS, through a series of sketches, fill a new catalog intended to advance the architectural use of lighting fixtures. Lighting Dynamics.

(17) LIGHTING CONTROLS and dimmers in standardized assemblies are described and illustrated with wiring diagrams, illustrations and specifications in 8-page bulletin 76P. Ward Leonard Electric Co.

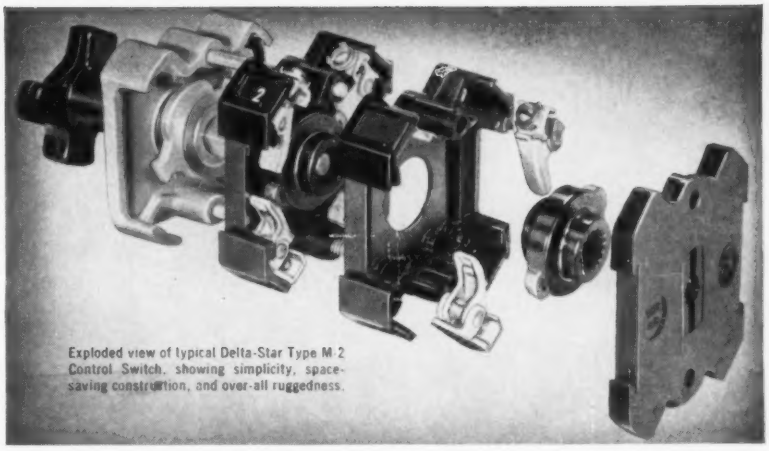
(18) BALLASTS for fluorescent lamps. Bulletin GEC-983L, 20 pages, gives prices and data on 184 different ballasts, including suggested replacements for obsolete units. General Electric Co.

(19) RACEWAY FILL. The latest specifications on the number of conductors permitted in each size of conduit or tubing are reported in new technical guide. Clayton Mark & Co.

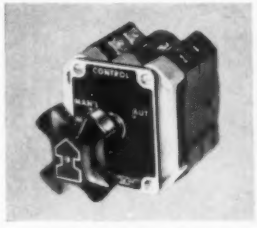
(20) MOTOR PROTECTORS. Fifteen questions about Klixon built-in, 3-phase motor protectors are answered in new 4-page illustrated bulletin PR-1243. Metals & Controls Corp.

(21) LIGHTING FIXTURES in the new Preslock series lock the inner frame firmly in position during normal use, but it may be released at a touch of the finger or with pressure from the relamping pole. 4-page catalog. Prescolite Mfg. Co.

(22) BRUSHES of carbon and graphite for all types of rotating machinery are described in new 12-page bulletin. Speer Carbon Co.



Exploded view of typical Delta-Star Type M-2 Control Switch, showing simplicity, space-saving construction, and over-all ruggedness.



Manual-to-Automatic Selector Switch with finger-grip handle



Ammeter Switch with knurled handle



Circuit-Breaker Control Switch with pistol-grip handle

Why compact DELTA-STAR Control Switches belong in your switchgear specifications

For all their compactness, Delta-Star Control Switches are rugged, long-lasting, and built with high interrupting capacity. Here are the features that give these switches improved efficiency, economy, and service:

Versatility—useful in many diverse ways—see examples listed below. They're rated for 20-amp. continuous service and 250-amp. short-time (up to 3 seconds) service. Many variations of standard instrument and control switches are possible, and special arrangements are available on request.

Small Size—only 3⅞" high by 3¼" wide. Angular position of terminals makes wiring easy, even when switches are closely spaced. Large terminal clearances and complete baffling between sections. Inspection is quick and easy.

High Interrupting Capacity. At 250vac inductive, single-break contacts have an interrupting capacity of 25 amperes, double-break contacts 75 amperes.

THESE AND OTHER FEATURES make Delta-Star Control Switches the *right* switches to specify when buying control panels and other switchgear. Call your Delta-Star representative for further details, or write *Delta-Star Electric Division, H. K. Porter Company, Inc., 2437 Fulton Street, Chicago 12, Illinois. District offices in principal cities.*

Some of the many types available

Circuit-breaker control • Manual-to-automatic selector • Voltmeter switches • Frequency meter • Synchroscope • Motor control • Ammeter switches • Power-factor meter • Regular transfer • General control • Wattmeter • Temperature meter

H. K. PORTER COMPANY, INC.

DELTA-STAR ELECTRIC DIVISION



Stockpiling like this means prompt delivery during Revere's move into big, modern plant

The production departments of Revere Electric Mfg. Co. have been working overtime to build up stock to insure continued prompt deliveries of outdoor lighting equipment while the company is moving into its new plant.

According to Murray J. Whitfield, Revere president, "We expect to be in our new plant in Niles, Illinois in May. This move has been carefully planned to avoid any inconvenience to our customers. Your orders will be filled from equipment which we have produced in anticipation of the move. Substantial supplies of floodlights, poles and luminaires are ready for immediate shipment."

"There will be no interruption or slowdown of our prompt delivery policy. We have seen to that!"



New 110,000 sq. ft. plant for Revere Electric Mfg. Co. located northwest of Chicago in suburban Niles. Modern research laboratories provide for complete testing of equipment. Carefully planned production and shipping facilities assure fast, efficient movement of products.

Revere ELECTRIC MFG. CO.®

OUTDOOR LIGHTING

Revere Electric Mfg. Co. • 7420 Lehigh Ave. • Chicago 31, Ill.

Available in Canada thru Curtis Lighting, Ltd., Leaside, Toronto, Ontario

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Fluorescent Color Correction

QUESTION V33—In our plant we have need for what is called extremely blue clear north sky light to properly inspect our product for true color. Our inspection area is lighted with 100 4-tube fluorescent fixtures. Since the cost of special fixtures and installation cannot be justified at this time, I would like to know if there are any special filters or special lamps that can be used to serve the purpose.—J.M.

ANSWER TO V33—Under the conditions outlined, the logical answer to JM's question is to relamp the 100 4-lamp fluorescent luminaires with deluxe cool white fluorescent tubes of the same size and wattage as now in use.

No mention is made of the type of luminaires now in use, nor of the color of the ceiling, side walls, floor and machinery, or work benches. Only three bits of information are given: 1) extremely blue clear north skylight color quality of illumination is needed for product inspection and color appraisal; 2) inspection area is lighted with 100- 4-lamp luminaires; 3) solution should cost very little money. If the luminaires are of the direct lighting type, ceiling and wall color and finish is not too important; however, if the luminaires are of the general diffuse or semi-indirect type, then the ceiling and side wall color is highly important. The color temperature referred to would probably range from 7000° Kelvin upwards. Daylight type fluorescent lamps are rated at about 6500° Kelvin. However, it has been found in practice that in most color discrimination (or color matching) work, a light source is needed which provides visible light radiation throughout the color spectrum (not to be confused with color temperature), ranging from ultra-violet and blue through the color spectrum to orange and red. Daylight type fluorescent lamps lack this radiation in the orange and red part of the spectrum. The deluxe type fluorescent lamps give off radiation throughout the visible spectrum, and are superior to the "daylight" type fluorescent lamp for this reason. The deluxe cool white lamps have an apparent "blue white" color to the eye, and is recommended for this reason. It is suggested that J.M. equip the luminaires in one bay with these lamps and try them out, with all other units turned off during the test. If these lamps solve his problem, the other luminaires can be relamped, and the cost held down to a minimum.—B.C.C.

LV-DC Generator

QUESTION W33—In the plant where I am employed we have dc magnetic brake coils to test, power being supplied from a 6-volt dc generator.

In trying to regulate the voltage to supply the current for which the coil is designed, it is necessary to lower the voltage to about 2 volts. When this is done the ammeter needle is very unstable, making it impossible to obtain a proper ampere reading. Can someone describe the cause of this instability of the meter needle and suggest a remedy? —B.A.S.

ANSWER TO W33—The description of the problem leads to a belief that B.A.S. is attempting to use a self-excited generator. When operated between certain critical points of magnetic flux density in the field poles, the machine generates an unstable voltage. This holds true even if the speed does not vary. Stability conditions are treated at length in collegiate grade texts on direct current machinery.

Some experimenting may be necessary to find the most convenient solution of the several alternates suggested, and the end result may be a combination of the suggestions. Possible solutions are: (1) testing coils in series (this will enable the generator operation at a higher voltage), (2) separately exciting the generator, either from another generator or from a battery (this will enable holding a constant field strength, regardless of terminal voltage fluctuations), (3) driving the generator at a lower speed (this must be offset by a higher field current, which may be comfortably above the critical point), (4) using an adjustable resistor in series with the coil under test (this is an alternate to the first suggestion, and "efficiency" is of no moment with the small amounts of power being used), and (5) using a 3-point resistor (full resistance is connected across the generator terminals, with the test voltage being obtained from one line and the resistor tap). When using resistors, another may be needed in the circuit for "fine tuning."—L.E.B.

ANSWER TO W33—I note that the method of obtaining the 6-volt dc is from a generator. I assume this is a motor driven generator. If this is so then the reason for the instability of the current readings is easy to understand. In order to reduce the voltage to 2 volts, you have necessarily reduced the field voltage to a fraction of its usual amount. The generator then operates on an unstable portion of its characteristic especially as it is operating into a highly inductive load.

In order to remedy this I would suggest that the dc generator be loaded with some resistance so that the generator looks at a much lower effective resistance than the magnet coil itself. This additional load will tend to stabilize the entire situation. On the other hand, an alternative suggestion is the construction of a simple dc power supply operated from a variable voltage transformer and selenium rectifier. The output impedance of such a power source would be very low and this would eliminate the variations in current that you have been experiencing.—H.H.S.

Amplidynes

QUESTION X33—It is claimed that the amplidyne eliminates short circuits and has practically no resistance in comparison with other motors of the same size. How is this done? Can the amplidyne be made to generate power by supplying mechanical energy to it?—E.B.

Kuhlman Power Center Transformers

POWER WHERE IT'S NEEDED–

with safety, economy and efficiency

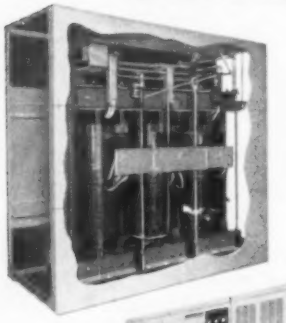
Illustrated here are some of the power center transformer types available from Kuhlman. These specialized transformers may be fitted to your specific requirements, as individual transformer components or as package units.

These power center transformers are especially suited for factories, hospitals, public buildings and office buildings. Power loss is minimized because high voltages are closer to the load. Costly secondary runs are eliminated, and expensive installations are unnecessary.

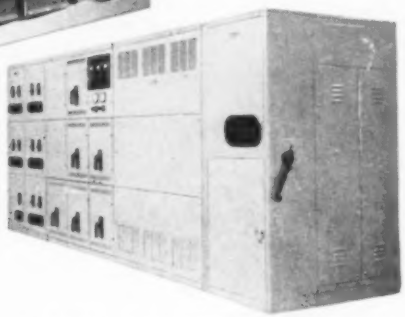
Either liquid or dry type transformer may be located at the load center with safety.

Units shown are examples only. Kuhlman power center transformer designs are flexible and adaptable for practically all specifications.

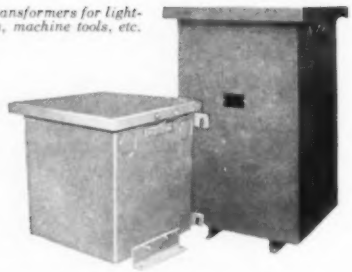
DRY TYPE



Designed for maximum 80° rise over ambient temperature of 40° C. Supplied as core and coil units, and as enclosed sections.



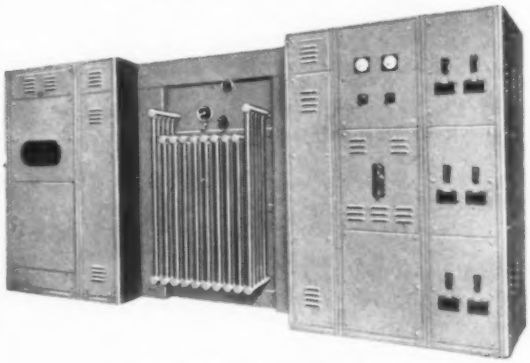
Dry type transformers for lighting circuits, machine tools, etc.



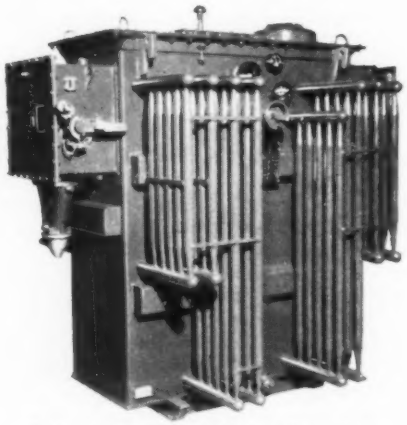


Standard indoor air cooled power centers. Compact unit suitable for lighting circuits and small power loads.

LIQUID FILLED



Indoor power center: Safe-T-Kuhl flush end constructed transformer, primary fused air interrupter switch and low voltage switchgear.



Outdoor power center: Oil-filled weatherproof constructed transformer with primary oil immersed switch and low voltage terminal chamber.

KUHLMAN

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ANSWER TO X33—The amplidyne, as defined by General Electric in its publication "The Amplidyne, Characteristics and Technical Data —GET-1985", is a compensated, armature-reaction-excited dynamo electric machine.

My experience with amplidynes has been that they are used as generators or specific control applications. It is a power amplifier providing high amplification and instantaneous response. They are basically dc machines with one set of brushes short circuited but can develop shorts and opens the same as other dc generators.

I suggest that E.B. write for the above mentioned technical information as I believe this will answer his questions.—E.M.G.

ANSWER TO X33—The Rosenberg generator operates on the amplidyne principle. That means the field is weak, the two main brushes are shorted, and two other brushes are installed between the two main brushes. A compound wound generator plus two fusetrons that are closely rated will be cheaper and will give better results.—H.S.

Drying Ignition Transformers

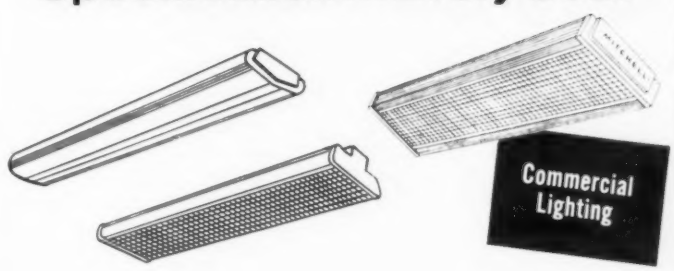
QUESTION Y33—What is an easy way to dry ignition transformers after a flood?—H.S.

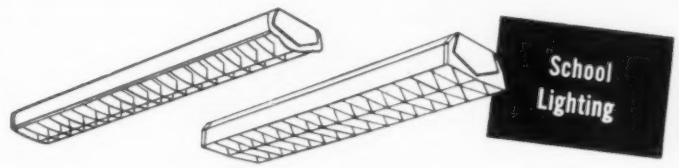
ANSWER TO Y33—There are two methods currently in use: (1) dry in a motor baking oven, preferably one with an air circulating system; (2) infra-red lamps. In either case, all mud and foreign matter must be removed first. This is best accomplished by use of a suitable solvent under low pressure. The drying process may be stopped when the insulation resistance is above one megohm per 1,000 volts.—J.M.

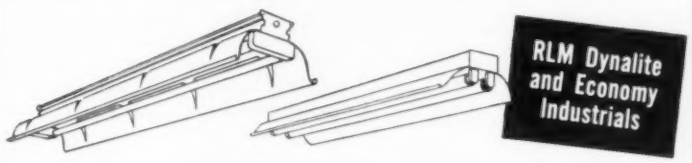
ANSWER TO Y33—I have found that the drying of wet oil burner ignition transformers has not proved practical or safe. I baked the wet transformers for a 24-hr period at a temperature of about 180 degrees to 200 degrees F. and then tested them, after cooling to room temperature, with a Megger for grounds. It was found that although the transformer ground resistance and resistance between windings was infinite, the secondaries on some were open. Those that checked OK were put in service and were found to fail

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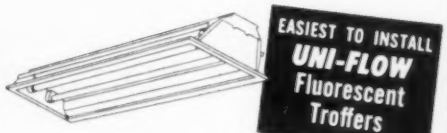
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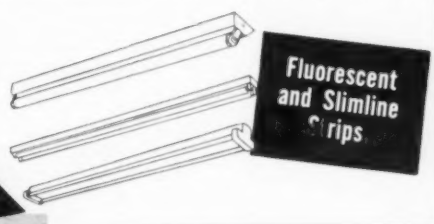






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entirely or would cause delayed ignition of the burner. The very fine wire used in winding the secondaries apparently is damaged by the small amount of moisture that is left in spite of the most careful baking and testing, and if all tests are good, then time and corrosion takes its toll. The best and safest solution is to replace wet transformers with new ones.—E.M.G.

Can You Answer These QUESTIONS

QUESTION J34—The advent of automation in our plant has brought with it maintenance problems of a complex nature particularly from the electrical end. The majority of our electricians have not been able to cope with understanding the operation of these complex control systems and naturally trouble shooting is not performed efficiently. Can someone with similar experience suggest a training program for these men which has proven successful in other plants in overcoming this problem?—R.E.B.

QUESTION K34—There are so many times that it is necessary to run motor leads (3-phase) quite a distance, which involves voltage drop. I know the formula for this problem but would appreciate knowing if some reader could tell where a chart could be found showing the amperes that could be run for several distances for the allowable 5% drop, or the drop that would occur for various amperes at various distances. The power factor could be taken at 75% or 80% of these figures.—C.S.S.

QUESTION L34—Is there any method of testing that could be used to determine if a squirrel-cage induction motor has a defective rotor?—J.A.M.

QUESTION M34—We have a problem in a fertilizer plant. Rigid conduit and galvanized junction boxes last about two seasons in the processing part of the plant before they rust away. We have thought about using plastic pipe. Has anyone had this same experience and solved the problem?—D.M.Q.

PLEASE SEND IN YOUR ANSWER BY JUNE 15



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Industrial high-voltage power circuits are free from transient faults. Conductors for such circuits run in cables or conduits. They are not exposed to lightning, falling trees, rodents, wind, or ice which typically cause transient faults.

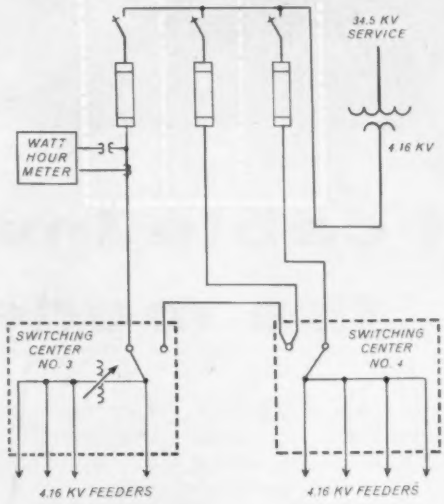
Consequently, the only faults that occur are permanent faults; thus these circuits cannot be re-energized immediately after an outage. Hence S&C Power Fuses give the right protection against such faults. The quick reclosing feature of expensive circuit breakers is not needed. Nor are circuit breakers (with associated differential relays) for protection against internal transformer faults justified in view of the reliability of modern transformers. This form of protection is particularly unwarranted for the kva sizes found in typical industrial load centers.

S&C Metalclad Switchgear, with power fuses instead of circuit breakers, and load interrupters for full load switching, can bring substantial savings in switchgear costs—sometimes as much as 50%.

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S & C METALCLAD SWITCHGEAR
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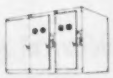
S&C Metalclad Switchgear serving as the main substation secondary at the Riverside plant substation, Universal Oil Products Company, near Chicago. Includes metering provision, two outgoing feeder circuits, and a common spare. Design, layout, and purchasing by Universal Oil Products Company. Electrical contractor: Fried Walters Company, Chicago.



SUBSTATION PRIMARY



MAIN SUBSTATION SECONDARY



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with Loxarmor — the modern armored cable whose strength and flexibility make it a cost-saving alternative to conduit-enclosed cable. Rubber-insulated Loxarmor with its interlocking S-shaped armor is ideal for either power or control circuits.

Lower installation costs — Loxarmor eliminates conduit and related installation costs such as making bends and using pull boxes... especially economical to use in cramped quarters.

Easier to add or re-route circuits — Usually trained in trays or racks, Loxarmor cables are easily re-routed and are 100% salvageable. New cables are quickly added to existing trays.

Use indoors or outdoors — Loxarmor can be used in wet or dry locations. Indoors or outdoors, Loxarmor cables are readily accessible for easy inspection and maintenance.

Less space required — Multiple Loxarmor circuits require only a little more than half the space needed for equivalent conduit circuits.

Loxarmor can be supplied over any standard Okonite insulation—rubber, varnished cambric or plastic—depending upon your installation conditions and voltage requirements. It is available with galvanized or stainless steel, aluminum or bronze armor. Either copper or aluminum conductors are of course available.

For dimensional data on Okonex rubber insulation applied by the strip-insulating process write for Bulletin EC-1090. Complete splicing and terminating drawings and instructions for Loxarmor are also included. The Okonite Company, Passaic, N. J.



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4740

Questions on the Code

Answered by:

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
GLENN ROWELL, *Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

Motor-Feeder Overcurrent Protection

Q. *Section 4362 specifies that the maximum protection for a feeder shall be the largest rating or setting of the branch circuit protective device for any motor of the group fed by the feeder (per Tables 26 and 27, chapter 10) plus the sum of the full-load currents of the other motors of the group.*

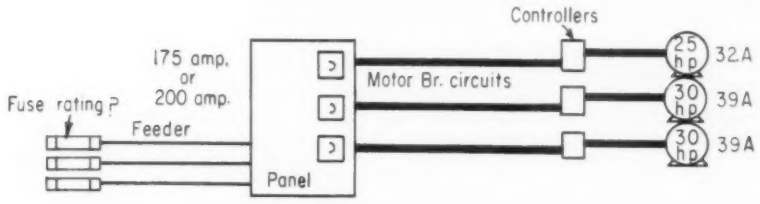
Example No. 8, Chapter 10, computes feeder protection using as the largest motor one drawing 32 amps. 300% of 32 is 96 amps, or 100-amp fuse. However, the example uses 96 amps rather than 100 amps, which is the rating of the fuse, in the calculations. While the difference is small, it could make a difference in some cases and be a point of contention. Which is correct?—W.J.N.

A. A literal reading of the provisions of Section 4362 indicates, as you say, that example No. 8, Chapter 10 does not correctly apply to these code provisions. For the benefit of our readers, I have endeavored to clarify the point of contention by the illustration. It is quite evident that the example does not use the rating of the fuse for the 25 hp motor in computing the size of the feeder fuse. It only uses 300% of the starting current of the motor. As a result the maximum size of fuse would be 200 amps instead of 175 amps as specifically stated in the example. On some applications this inconsistency could involve the use of the next larger size fuse block such as the one rated 201–400 amps. If for example the 25-hp squirrel-cage induction motor was rated 30 hp we would find that a 201–400-amp fuse block would be required, if we followed the provisions of Section 4362 and a 200-amp block would be sufficient if we followed the example. This could be the source of considerable controversy in the field and it appears to me that the example should be corrected in line with Section 4362.

Another point which appears to be involved concerns the provisions of Section 2403-a. This section of the code does not include a 175-amp fuse in the list of standard fuses. It recognizes the use of such a rated fuse but it appears to me that it would not be required, and the example is incorrect when it states that the maximum size of fuse to be used is 175 amps.

EXAMPLE NO. 8. CHAPTER 10.

Example: Determine the size of the conductors, the motor-running overcurrent protection, the branch-circuit protection, and the feeder protection, for one 25 hp squirrel-cage induction motor (full voltage starting) and two 30 hp wound rotor induction motors, on a 440-volt, 3-phase, 60-cycle supply



Size of feeder fuse as covered by example:
300% x 32 + 39 + 39 = 174 amps and a maximum size of fuse to be used is 175 amps

Or

Size of feeder fuse as covered by section 4362: 300% x 32 = 96 amps. Fuse rating 100 amps. 100A + 39 + 39 = 178 amps and a maximum size of fuse to be used is 200 amps.

Section 4362 also applies to circuit breakers, and an error similar to the fuse computation is made in the case of the circuit breaker computation. In both cases the example takes the starting current of the first motor and adds the full-load currents of the other motors. I personally believe that your observation is significant and I am, through copy of our correspondence, bringing the matter to the attention of Mr. Biester, Chairman of Panel No. 11, National Electrical Code Committee.—B.A.McD.

Transformer Bank

Q. *We are about to install a transformer bank adjacent to a manufacturing plant in our city in order to increase service capacity, and the specifications call for this installation to be made on a concrete pad located approximately 5 ft distant outdoors from the exterior wall of this building. This exterior wall is concrete block; however there are window openings in it with one directly opposite from the transformer bank, and the roof is not parapeted. As the building is only one story in height, we are wondering if this will be a code violation if we do not provide a fireproof barrier between these transformers and the building. As such a barrier was not mentioned in the specifications, its cost was not figured in the bid. However, the specs do state that the installation shall be in conformance with the National Electrical Code and the architect is denying us an extra for this barrier.—T.C.*

A. Section 4524 of the code would require not only a barrier but also a means of directing oil away from the building in the event of a transformer tank failure, as this section reads as follows:
"Combustible material, combustible buildings and parts of buildings, fire escapes, door and window openings shall be safeguarded from fires originating in oil-insulated transformers installed on, attached to, or adjacent to a building or combustible material. Space separations, fire-resistant barriers and



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enclosures which confine the oil of a ruptured transformer tank are recognized safeguards. One or more of these safeguards shall be applied according to the degree of hazard involved in cases where the transformer installation presents a fire hazard. Oil enclosures may consist of fire-resistant dikes, curbed areas or basins, or trenches filled with coarse crushed stone. Oil enclosures shall be provided with trapped drains in cases where the exposure and the quantity of oil involved are such that removal of oil is important."

While you did not state in your question as to the capacity of the transformer bank in question, it is, of course, assumed that the total kva capacity is in excess of 112½. If the roof of this building is of fire-resistive construction, it might be possible to brick up the exposed windows on the side of the building wall adjacent to these transformers and in that way save the cost of a masonry barrier between the transformer bank and the building wall. However, if the roof of this building is of combustible construction, it would be necessary to provide either this barrier wall or a parapet above the roof.—G.R.

Service Condulets

Q. *We have a code question for which we would like some interpretation thereon. In electric service entrances there is some question about the proper type of condulets to be used because of the length of the bend with which the service entrance wire is to be made with. Is there anything in the code which requires that services of the larger sizes, say 2-in. to 3½-in. or 4-in. must use LBD type of condulets rather than LB in either form 6 or form 8 condulets? We have been informed on a certain job that we must use the LBD type in a 3½-in. size, however, we are unable to locate anywhere in the code where this is specific. We would like your reply as to the advantage of the LBD, if it is required, and the reasoning back of your replies. There is no doubt that possibly the LBD would be a good condulet to use; however, in the cost of installation there is quite a factor. The LBD being almost exactly twice the cost of the LB series 8.—G.W.T.*

A. While the code does not specifically cover the question raised, there are several rules which indicate that the code is concerned with the protection of

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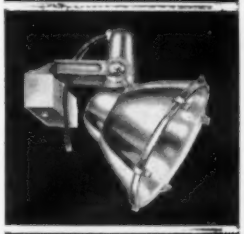
Revere floodlights are precision-engineered to achieve highest output combined with uniform light coverage. Dependable, easy-to-install Revere Floods are specially designed for easy re-lamping and cleaning. You can depend on Revere's long experience and sound engineering to solve your particular outdoor lighting problem.



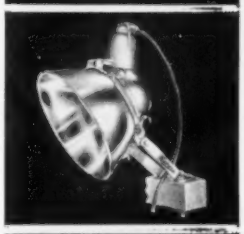
Low cost, broad coverage 22-inch Eliptor floodlight is made of vitreous-fired porcelain enameled steel with choice of colors, or aluminum. Enameled steel model available with or without Alzak finished aluminum reflector. Inside of aluminum model has Alzak finish for best light projection. Wide range adjustments provide for accurate settings. Use 300 to 1500-watt incandescent or 400-watt mercury lamps. 3800 Series.



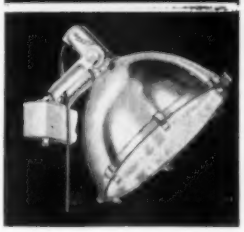
Small size aluminum floodlight, 12, 14 or 16-inch, is available either open or enclosed with clamp or hinge-type cover. Reflector is spun aluminum with etched Alzak finish for wide beam, polished Alzak for narrow beam. Housing is cast aluminum. Use incandescent lamps from 200 to 1000 watts. 7100 Series.



High power general purpose 18-inch floodlight for large areas. Wide or narrow beam Alzak aluminum reflectors. Hinged cover clamps to reflector for tight seal. 18-inch heat resisting lens available in plain, stippled or ribbed glass. Swing-over feature allows easy maintenance. Use 750, 1000 or 1500-watt incandescent or 400-watt mercury lamp. 4200 Series.



High power, rear service 18 or 20-inch floodlight has hinged rear reflector opening for safe, easy cleaning and relamping. Reflectors have Alzak specular or Alzak diffuse finish for narrow or wide beam. Front and rear sights enable accurate aiming of beam. Use 750, 1000 or 1500-watt incandescent lamps. 2000 Series.



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   TV mast holder and lead-in entrance.
3. **Wall Plates with Plug**
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4. **Heavy Duty 300 ohm TV Lead-In**
   Ample supply for any home.
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   Protects TV lead-in.

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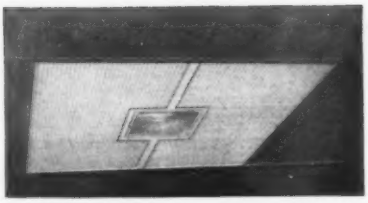
conductors when same are installed in a conduit system of wiring. Table 4, Chapter 10 limits the number of conductors installed in a conduit to approximately 40% of the area of the conduit so that the conductors will be protected from mechanical abuse when they are being installed. Section 3471 limits the number of bends in a run of conduit for the same reason.

In the case of the 3½-in. service in question, which could contain as many as four 500 MCM conductors, I personally would question the use of an LB condulet since it is not large enough to permit the installation of such size conductors without possible injury. Several years ago I visited a job under construction where such a service was being installed. It was practically impossible for the wiremen to make the right angle turn at the LB condulet, and when I appeared they were using a two by four with a sledge hammer to force the conductors protruding from the condulet through the nipple to the service equipment. Such procedure not only subjected the wire to mechanical injury but was also in violation of Section 1104-a. At that time, I required a mogul type of condulet to be used and found it to be satisfactory. The LBD condulet is also designed to facilitate the installation of conductors through a 90 degree bend, and I personally believe the inspector, on the basis of previous field experience, may require the use of such a type of condulet in line with the provisions of Section 1104-a.

I know from experience that some contractors, regardless of the inspector, would not use an ordinary LB condulet when conduits larger than 2 in. with large size conductors are involved.—B.A.McD.

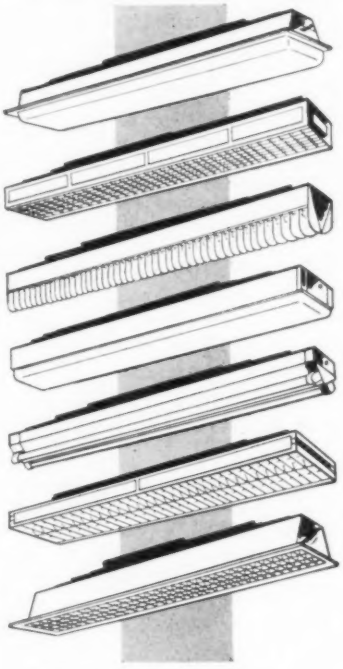
Comment

"Your item 'Lighting for Showcases' on page 194 of the March issue is in error. I consider it perfectly possible to locate ballasts in boxes under showcases keeping these boxes accessible. In fact, the National Electrical Code indicates such treatment as advisable in order to keep the secondaries as short as possible. Furthermore, Section 4184 in my judgment has no bearing in this case, the 1½-in. stipulation applying only to fixtures on combustible fiberboard." — J. M. Turnbull, Western Massachusetts Electric Co., Springfield, Mass.



WILEY

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Cat. No. 121-U Megaphone Projector



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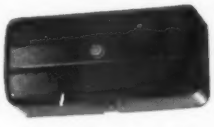
AC "CM" VIBRATING BELLS
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Cat. No. 101



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AIR TRUMPETS
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Location of Seal Fittings

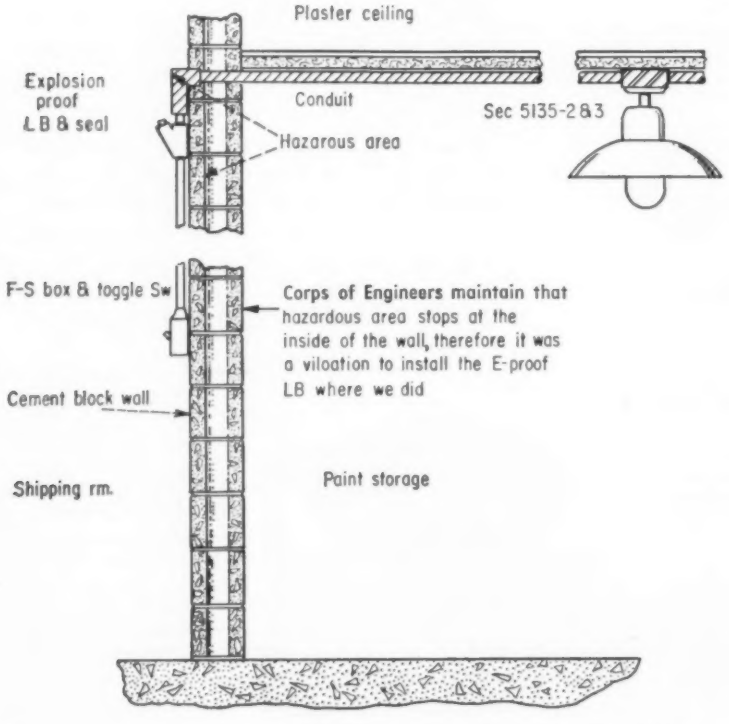
Q. *We recently completed a job for the Corps of Engineers. Our installations in hazardous locations were not approved because of an explosion-proof LB which I had placed on the outside wall of each enclosure.*

My reasoning was that Art. 510–5135–c–2 makes this wall, being of hollow blocks, within the hazardous area and that Art. 510-5135–c–3 makes the LB in question, partly in and partly out, considered to be in the area. I felt that it was correct to use a fitting in this location. I have shown a sketch of these installations and would appreciate it very much if you would clarify this section of the code for me.—L.B.

A. Section 5135–c–2 and c–3 of the N.E. Code applies to combustible anesthetics which are used in operating, delivery and anesthesia rooms of a hospital occupancy. Since your question concerns a paint storage room, there is question with respect to applying such rules to the installation in question. Regardless of the foregoing however there is a code violation which concerns the location of the seal fitting. According to Section 5135-e seals shall be provided as covered by Section 5015. Reference to Section 5015-a-2 indicates that there shall be no union, coupling, box or fitting in the conduit between the sealing fitting and the point at which the conduit leaves the hazardous area. You have installed an explosion-proof fitting where the conduit leaves the hazardous area and since such fittings are not gas-tight, any explosive gas contained within the conduit system in the hazardous area could leak out into the non-hazardous area. While I agree that Section 5135–c–2 classifies the hollow space in a masonry wall as a hazardous location, there is a question with respect to its application to a paint storage room. I do believe, however, if the position of the seal and the fitting is reversed, there would be no code violation.

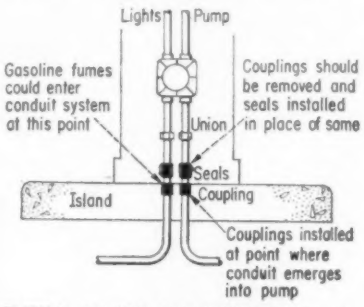
The status of a paint storage room would be covered by the general rules of Article 500. Since this Article does not classify the hollow spaces in a masonry wall as a hazardous location, it appears to me that the wall itself is considered to be the boundary between the non-hazardous and the hazardous area. As a result the seal could be installed on either side of the boundary as covered by Section 5015-a-2. It is also significant to note that the hazardous area of a hospital operating room only extends to a level of 5 ft above the floor, and it appears to me that this limitation would also apply to the hollow spaces in the masonry wall.—B.A.McD.

FIELD MAINTENANCE SHOP



Gasoline Dispensing Pump Seal

Q. *Section 5120-f. Sealing.* 1. *—An approved seal shall be provided in each conduit run entering or leaving a dispensing pump or other enclosure on a dispensing island. There shall be no union, coupling, box or fitting in the conduit between the sealing fitting and the point at which the conduit emerges into the pump or other equipment, or into any cavities or enclosures in direct communication therewith.*



TYPICAL ISLAND GAS PUMP ROUGH-IN

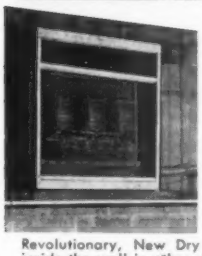
2.—*Since a seal-off and a union are necessary in each of the conduits, would you please draw in their proper locations? See illustration.—R.F.*

A. According to your illustration the two conduits supplying the dispensing pump terminate in couplings buried in the concrete island supporting the pump. These couplings appear to be flush with the top of the island, and if so are located where the conduit emerges into the pump. If this is correct, seal fittings should be installed in place of the couplings shown. Usually there is a small cavity under the pump at this point so that such fittings may readily be installed. If we leave the couplings in as shown and then install a short nipple and the seal fitting, gasoline fumes accumulating within the pump enclosure could enter the underground conduit system through the coupling, and this is what the code rule intends to prevent. For the benefit of our readers, I have shown your illustration to clarify the point of contention. In order to rectify the condition the conduits should terminate in seal fittings located either in a cavity or in the pump itself.—B.A.McD.

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DRY
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5000 KVA
—15 KV
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WET
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5000 KVA
—69 KV

Here's how to "SPECIFY" for low noise level Transformer Installations

DRY TYPE APPLICATION DATA

INSTALLATION INSTRUCTIONS

1. Transformer is to be mounted in such a manner that it is not directly tied to any of the structural parts of a building.
2. Connections between transformer and other equipment such as junction boxes, panel boards, troughs, etc. are to be made with flexible conduit, preferably of a Neoprene jacketed type.
3. All Electrical connections to transformer to be made with flexible conductors.
4. Transformers are to be located in areas where sound reflection and standing sound waves are at a minimum.
5. Transformers are to be isolated by vibration dampening material (as recommended by manufacturer) from tile, brick, concrete, masonry-walls, floors and ceilings.
6. The mounting of transformers on light weight or small mass, walls partitions, floors, etc. *are to be avoided.*
7. The use of special sound absorbing acoustic materials *should not be necessary* for wall and ceiling use and is to be avoided.
8. For *extremely low noise* level installations a transformer, having its core and coil unit isolated from its enclosure and enclosure mounting, is to be used. Items one through seven are also to be adhered to.
9. The transformer used is to be one whose original design had been tested for DB level per NEMA ST 1.411.
10. The transformer is to have a DB level either equal to or less than the ambient sound level of the area in which it is installed—SPECIFY P.T.C.

—CORRESPONDING SOUND OF DECIBEL VALUES

TYPICAL SOUND LEVELS

Over-all Sound Level in DB	Produced by Well Known Sources or in Familiar Location
0- 10	Very soft whisper Ticking of a watch Empty school room or theatre Treshold of audibility
10- 20	Tear thin paper Studio for sound pictures Windless desert Normal whisper
20- 30	Rustle of leaves in a gentle breeze Broadcasting studio Country roadside
30- 40	Low conversation Residence, evenings
40- 50	Quiet automobile Private business office Normal conversation Average residence
50- 60	Light traffic at 100 feet Moderate restaurant clatter Vacuum cleaner
60- 70	One typewriter Information booth in large railway station Average traffic at 100 feet Accounting office Motor truck at 100 feet
70- 80	Radio receiver at full volume Office with tabulating machines Automobile at 20 feet distance
80- 90	Average motor truck passing at 30 feet 10 HP outboard motor at 50 feet distance Inside motor bus
90-100	Home run at ball game Inside of noisy subway car Can manufacturing plant
100-110	Inside of DC-6 airliner Weaving room Woodworking shop
110-120	Pneumatic chipper at 5 feet distance Engine room of submarine Jet engine test control room
120-130	Thunder 4-propeller airliner Boiler shop
130-140	Treshold of feeling Jet airplane at take-off

PTC-CORE AND COIL UNITS

Audible sound levels for PRECISION dry type self cooled single and three phase distribution and power transformers (in decibels).

KVA TRANSFORMER RATING	PRESENT NEMA	RECOMMENDED NEMA	PRECISION AVERAGE SOUND LEVEL	"SPECIAL" AND HUSH FLUSH SOUND LEVEL AVERAGE
0 - 7.5	50	45-50	40	32
9 - 30	55	50	41	34
37.5- 112.5	60	55-60	43	38
150 - 300	65	65	45	42
301 - 500	68		50	47
501 - 700	70		55	52
701 -1000	72		60	54
1001 -1500	74		62	56
1500 -2000	76		64	58

See our complete catalog in Sweets
INDUSTRIAL CONSTRUCTION FILE 11a-Pr

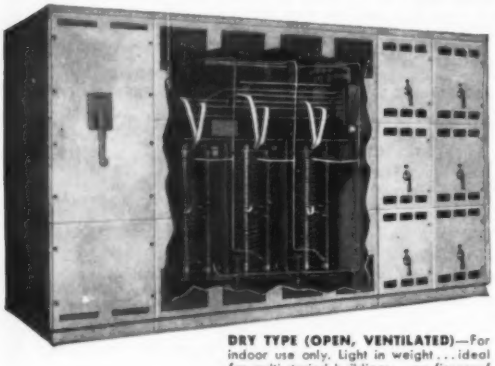
PTC

PRECISION TRANSFORMER CORP.
2218 W. LAKE STREET • CHICAGO 12, ILL.



WAGNER UNIT SUBSTATION TRANSFORMERS

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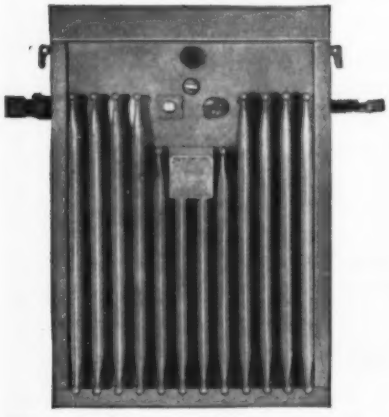
DRY TYPE (OPEN, VENTILATED)—For indoor use only. Light in weight . . . ideal for multi-storied buildings . . . no fireproof vaults necessary.

Nothing is more important to your plant than an uninterrupted flow of power. You can't afford to be handicapped by a system that is unable to meet expanding demands.

It will pay you to check over your distribution system—find out how adequate your transformers are for present and *future* load requirements.

And it will pay you to specify Wagner PREDESIGNED Transformers for your load-centers. You will save time—save job engineering costs—and get liberally designed transformers with the switchgear of your choice. Wagner PREDESIGNED Transformers are engineered to meet heavy industrial demands. They are built in standard ratings which are coordinated with the specifications of unit substation builders.

Bulletins TU-205 and TU-214 give full information on Wagner Unit Substation Transformers for industrial power needs. Write for your file copies today.



CLOSE-COUPLED. These transformers fit flush against switchgear enclosures, eliminating throats and saving space . . . available in ratings from 500 through 2000 kva.



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OIL AND NOFLAMOL-FILLED. Oil-filled transformers are generally used outdoors. Noflamol type is filled with a noninflammable liquid making it especially suitable for locations where explosive liquids and gases are present.

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ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

Rolling Grate and Guides Facilitate Coil Burning

Several details related to a firebrick-lined burning enclosure simplify fast, accurate positioning of stators above a gas-jet piping arrangement in the shop of the Electric Motor Repair Co., Baltimore, Md. As noted, the angle grate is castor-mounted to permit its being moved easily in or out of the fire-

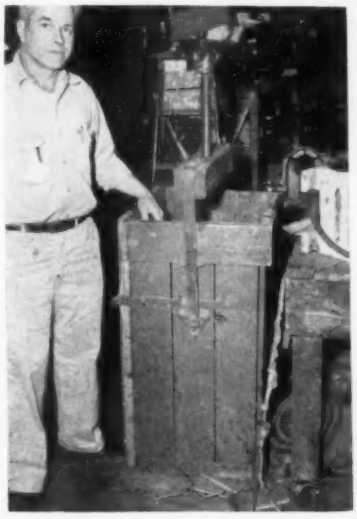


INWARD BENDING of floor-secured angle guides insure accurate positioning of rolling grate above gas-fired burning assembly in this open-front firebrick enclosure.

place, while angles, secured to the hearth, are bent inward at their forward ends to accurately align the grate as the latter is being pushed over the burning rig. Heat is obtained from a serpentine pattern of multiple-jet pipe sections, while exhaust fumes are directed up the flue by means of a small exhaust unit.

Compression Baler for Copper Salvage

Salvage and sale of scrap copper wire is an important, profitable chore at Bill Dreis, Inc., a modern motor repair shop in New Orleans, La. This shop specializes in the repair and rewinding of fractional hp motors for tools, appliances and other small machines. In the course of each day, a substantial amount of scrap copper is removed from old motors in the form of windings. Bill Dreis has organized shop operations so all of this wire is saved and thrown into the shop's baler.



BILL DREIS, manager of his own modern motor repair shop, demonstrates operation of the simple baler which enables him to salvage scrap copper and sell it at a profit.

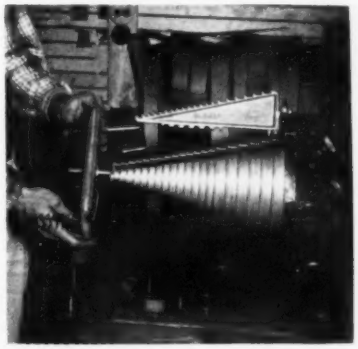
As shown in the accompanying photo, this baler is a collapsible wooden box assembly with a screw-driven press bar attached to a yoke at the top of the box. When the box is nearly full with loose scrap wire, the baler press is turned down on the board. By tightly pressing the board down, the scrap wire is compressed into a small, compact volume. The bundle is then strapped while still in the baler.

The packaged bundles of scrap copper are stored out of the way at one end of the shop until the scrap dealer picks it up.

Split-Phase Coil Jumpers Reduced by Spring Holder

Two coil groups for a split-phase motor can be wound with a continuous wire in the shop of the Electric Motor Service Co., Chester, Pa. This is made possible through the use of a simple coil-holding device consisting of an 8-in-sq plywood board equipped with three hooks. The hooks may be easily pushed outward from the board by thumb pressure, while coil springs act to hold the hooks firmly against the board when thumb pressure is removed.

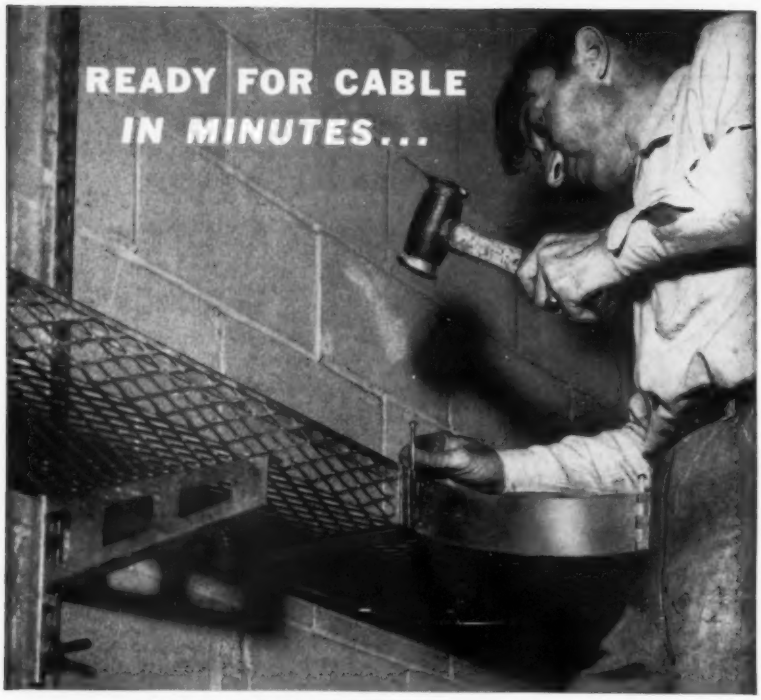
This plywood base is placed on the winding head and, when one coil group has been wound, the hooks are pushed forward to grasp



SPRINGS are pushed forward from plywood base to grasp split-phase coil group. Release of pressure pulls group snugly against board while second group is wound. Result is halving of jumpers, plus conservation of time and energy and improvement of product and appearance.



CHANNEL BASE and adjustable bent steel uprights are used to support small armatures in shop of Electric Motor Service, Kennett Square, Pa., while reach of bracket may be adjusted by means of series of drilled holes in base, holding bolts and locking thumb screws.



An aluminum coupler plate and two steel pins do the job—with Cope's patented pin-type coupler.

Cope cable trough cuts labor costs to a fraction!

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- **LOWER SYSTEM MAINTENANCE COSTS**

Discuss these advantages for *your* installation with a qualified Cope representative—or write to T. J. Cope Division, Rome Cable Corporation, Collegeville, Pa.

1001

T. J. COPE *Division*

ROME CABLE CORPORATION

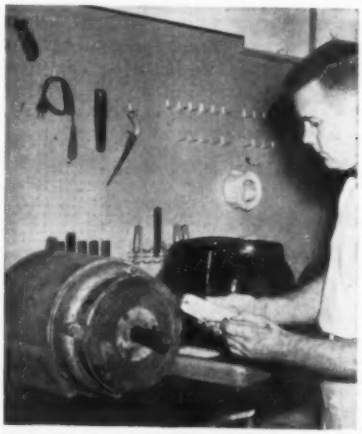
the coil. Release of pressure pulls the coil against the plywood base, preventing its unravelling or snarling. A second group is then wound in the same manner, after which the two groups are removed from the winding head and the process is repeated.

By winding two groups together in this manner, the number of jumpers required for each rewinding job is reduced by 50%, saving time and producing a neater job.

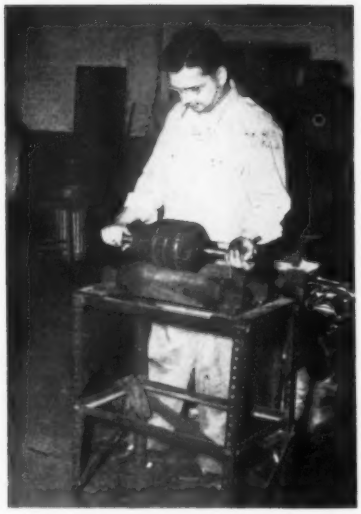
Checklist Motor Tag Simplifies Pricing

All motors received in Bob Swanson's Electric Motor Service shop in Kennett Square, Pa., are promptly tagged for identification, repair and billing purposes. The customer's name plus the make and hp of the motor is marked on one side of the tag. The other side contains a checklist so that those who work on the motor can quickly and simply indicate the extent of the work (such as minor, major or complete rebuild) and the materials required (such as ball- or sleeve bearings, brushes, armature repaired or rewound, starting switch, governor, condenser, rewinding, etc.). Space is also provided at the bottom of the tag for any additional information which might be pertinent.

Even when more than a single mechanic performs work on a motor, the checklist permits a complete record to be recorded with a minimum amount of effort. And, when billing is in order, the tag forms the basis for related charges.



CHECKING THE CHECKLIST is shop-owner Bob Swanson, who reviews the scope of the repairs before recording the service charge related to this motor. Tag also serves as identification means and condensed work sheet.



WOODEN ROLLERS in bearings mounted to top of angle-iron stand is useful shop device for rotating armature being inspected or repaired. This simple solution comes from Electric Motor Service of Chester, Pa.

Oven Door Serves As Auxiliary Table

By attaching a U-shaped pipe-formed bracket to the sides of an oven door, shop workers for Electric Motor Repair in Baltimore have come up with a useful auxiliary bench directly in front of the burning area. The pipe bracket is dimensioned and positioned so that the oven door is horizontal when in the opened position. And, since the bracket is pivot-mounted, it folds down flat against the door when the oven is closed.



U-SHAPED BRACKET on oven door folds flat when door is closed; serves as sturdy support when door is opened.

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PNF PULLING ELBOW
Two female threaded hubs at precise 90° angle. Rigid, domed covers with full neoprene gaskets. Sizes ½" to 2".



PNH PULLING ADAPTER
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QUICK, EASY-TO-USE



Pull wires straight thru conduit and one side of elbow.

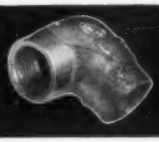
Make big loop of wires and pull thru other side of elbow and conduit. No obstructions inside elbow—gives smooth travel.

Pull wires taut from other end of system—cover attaches quickly with big screws, opens easily anytime.

MADE BETTER FOR YOUR NEEDS

- malleable iron, cadmium plated, chromate treated
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- cover domed for greater rigidity, provides more working space and more wire area inside
- full neoprene cover gasket (not cut out)
- milled surfaces assure tighter seal
- more metal at inside radius provides more strength, durability
- no obstructions inside, all smooth surfaces, tapped holes recessed
- precision tapered pipe threads positioned exactly 90° center to center in the same plane
- sold complete with covers, screws and gaskets — shipped assembled
- sizes marked on both covers and elbows

"L" TYPE PULLING ELBOW ALSO AVAILABLE
Malleable iron body has two female threaded hubs, at 90° angle. No-thread type also available. Swing style, steel cover attached to body. Angular opening permits straight pull of wires. Gaskets available at extra cost. Sizes ½" to 1".



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Your Name_____

THE GREEN HORNET

Velocity Power's new multiple fastening tool drives studs quickly, accurately, safely

1. 2. 3.

After selecting correct barrel, cartridge, stud and protective shield, open breech with a slight twist of the handle.



Insert pre-assembled stud. Close breech with a half-turn, counter-clockwise.



Position tool on fastening point. Push handle forward. Apply slight pressure. And fire.



A variety of industrial fastening jobs that used to take *hours*, can now be completed in *seconds* with the new Green Hornet.

The load-position-fire operation of this versatile tool makes stud driving as easy as shaking hands. Starting with the hand-contoured grip and trigger-activated firing assembly — and continuing right on down to the permanently attached protective spall-shield, the Green Hornet is designed for easy, economical use.

This new stud driver utilizes the power of blank cartridges in firing pre-assembled studs into steel, masonry or concrete. The sturdy steel studs anchor piping, conduit, electrical boxes, and curtain walls with a minimum expenditure of time and money.

Safety features further increase the user-benefits. A steel piston press-fitted to the end of the stud unit automatically binds the stud if it should waver off its firing course. This binding in the barrel cuts the velocity of the stud, prevents dangerous richocheting. Operator must hold the tool against the work surface with an exerted force of at least five pounds before the firing mechanism can be cocked, so accidental firing by dropping the tool is impossible.

Our new bulletin has the complete story. Write for your copy.

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Northeast IES Members Convene in Connecticut

Delegates to the Northeastern Regional Conference of the Illuminating Engineering Society, convening at the Statler Hotel in Hartford, Conn., April 10-11, were unanimous in commending an unusually "meaty" technical program which was presented in four sessions during the 2-day assembly. In fact, the "timeliness" of the meeting was such that several reports concerned Task Committee Recommendations which have not yet been published; several just-introduced lighting components were exhibited and discussed, while progressive thinking was evidenced repeatedly in remarks and slide illustrations of the thirty speakers who participated in this informative conference.

Of special interest was a report by Cash Crouch, the Society's Technical Director, who discussed New Footcandle Recommendations based upon an 8-year research project conducted under the supervision of Professor H. R. Blackwell, Director of the Vision Research Laboratories at the University of Michigan (see W. T. Stuart's editorial in EC&M, April, 1958). Timeliness of this report was indicated by the fact that these recommendations have not yet been officially approved by IES Council and, therefore, are not yet generally available.

Findings of this research project suggested that footcandle recommendations for many activities should be raised materially: to 70 for ordinary classroom work and general reading; to 100-200 for various office practices, reading carbons of manuscripts, sewing, general display of goods in self-service stores; to 500-1000 for show cases, reading tracings; and from 2000 to over 10,000 fc for such critical seeing tasks as studying some types of textiles, reading vernier calipers, etc.

A second report pertaining to proposed Lighting Practices, this one for schools, was presented by John Chorlton of the Toronto Board of Education who, as chairman of the Toronto Section, will be the local host for the Society's national conference in that city next August. The report, he stated, was the result of joint thinking between three groups most concerned; the IES, architects and educators who appointed a task committee to investigate this subject in 1952. Now, after six years of extensive research, the report is nearing completion and should appear in published form within the coming year.



24 LIGHTING AWARDS were presented to 19 individuals in Philadelphia recently, representing the prize winners in the 1957 International Lighting Competition for that area, and the record for any one city in the nation. Shown here are (l to r): Paul H. Scherr, architect; C. Daniel Weyman, consulting electrical engineer; H. Gelman, electrical distributor; George Swint, plant engineer; and W. W. Garey, publisher, Electrical Construction and Maintenance, who presented the certificates on behalf of the sponsors—McGraw-Hill electrical publications and National Lighting Bureau, NEMA. Electrical contractors won eight awards, and Philadelphia Electric Company lighting specialists won eleven awards.

Office Lighting Panel

Another conference highlight was a 5-man panel discussion on "Problems in Lighting New Office Buildings". Participating were electrical contractor John T. Dolan of Bauer & Co. of Hartford and present president of NECA's Central Connecticut Chapter; lighting maintenance exponent Francis Clark of Lighting Services in Waterbury and a charter member of the National Association of Lighting Maintenance Contractors; consulting engineer Joseph L. Ottenheimer of Albany, N. Y.; architect Dwight E. Smith of Smith & Persse of New Haven and present president of the AIA's Connecticut Chapter; and utility representative Edward R. Cole, associate illuminating consultant for the Hartford Electric Light Co.

In an absorbing 2-hour discussion of this subject, this quintet thoroughly analyzed lighting planning and esthetics, business ethics, availability and distribution of equipment, adequate wiring, Code and local ordinance provisions, cooperation and coordination with other trade groups on the job, dealings with owners and manufacturers, functions of consultants, personnel problems, brightness ratios and glare problems, recommended footcandle and watts/sq ft values for different occupancies and types of service, necessary information to be obtained before plans can be drawn up, writing and interpreting specifications, "or equal" clauses, allocation of responsibility, scheduling of jobsite deliveries, discount structures, provisions for subsequent maintenance of equipment, bidding practices, and many other equally pertinent problems.

Highway Lighting

Speaking on Highway Lighting, Dana Rowten of Westinghouse first reviewed the historic development of higher efficiencies for the three basic light sources (incandescent, fluorescent, m-v), then related this development to parallel evolutions in reflectors, refractors, methods of shielding, control and patterns of candle-power distribution.

The design and application of Higher Output Flourescent Lamps was the subject of a talk by General Electric's Russell Churchill, who presented charts and slides to illustrate how lamp efficiencies and outputs can be varied by changing

internal pressures, types of gas, voltage levels, amperage, diameter of tubes and cross sectional configurations.

Maintenance Factors

Another subject that prompted considerable audience participation was an analysis of Maintenance Factors by Willard Allphin of Sylvania and John Neidhart of the Miller Co. In this presentation, factors contributing to lumen depreciation (such as room occupancy, luminaire design, air movement and nature of dirt) were considered thoroughly, as were methods and components used in general maintenance practice.

In a discussion on Light for Plant Growth, Joe Ditchman from G. E.'s Nela Park presented data to show how plants and animals depend upon photosynthesis for their food and growth; that is, upon the manufacturing of carbohydrates from carbon dioxide and water in the presence of light through the mechanism of chlorophyll. He also discussed the flowering response of various plants to photoperiods, that is, to duration and patterns of light and dark. This knowledge, compiled over a quarter-century of research, now aids florists in controlling the time of blooming; adapts varieties of plants to different sections of the country; permits vegetables and fruits to exploit seasonal markets; increases egg crops on poultry farms; induces fur-bearing animals to grow heavier pelts; and improves the health and weight of hogs and cattle.

Home Lighting Activity

The subject of Residential Lighting, reviewed by Miss Myrtle Fahsbender of Westinghouse, again emphasized the fast pace that progress in lighting is setting, for she exhibited and discussed dozens of new products and techniques which have come into being just during the past year. Her displays included such things as molded fixtures-within-fixtures, the use of decorative glass mediums around central diffusing bowls, all-in-one diffusion bowls with shades, floor-to-ceiling adjustable pole tracks for adjustable placement of fixtures, "packaged" luminous ceilings, pantograph brackets for wall lamps, mercury-vapor garden-lighting units, ceiling tracks and cable reels for lateral movement, weighted pull-down devices for vertical positioning, several new dimming devices, etc.

In his formal address, national president Kirk Reid related the growth of the Society to that of the lighting industry as a whole, referring to progress in the fields of lighting sources, luminaires, research and application as well as to the Society's growth in service, membership, financial stability, technical activity and dissemination of practical knowledge.

Kirk likewise reviewed several areas of unusual significance, including educational programs for students at high school and college level; lighting design competitions being promoted by the Society's Allied Arts committee, and joint research projects being carried out with other technical groups (such as the AIA, AIEE and EEI) and with governmental and civic groups at local as well as national level.

As usual, the session devoted to presentations by MMILJ contestants attracted a full house; and, with all Northeastern sections and chapters represented by entries, many interesting problems and solutions in both the residential and non-residential divisions were illustrated and discussed. Regional winners, who will again compete for national honors at Toronto in August, were Neil S. Florence (New York Section) who discussed periphery lighting of tower floors in the new commercial House of Seagrams, and S. Shemitz (Connecticut Section) who discussed inbuilt interior and exterior lighting features of a deluxe residence. Other contestants included H. Young (whose presentation was that of a utility control room); W. Reeves (a high-speed servicing depot for trains); B. Barry (lighting of a retail wine store); John Gould (lighting in a model home); and R. Cole (who also discussed illumination techniques in a luxury residence). Presiding chairman for the contest was Robert Babcock (chairman, Connecticut Section). Judges included Miss Myrtle Fahsbender, Westinghouse; Miss Ruby Redford, editor, *Illuminating Engineering*, and Clifford Forrester, Western Massachusetts Electric (residential); C. W. McCormick, Conn. Light and Power; John J. Neidhart, The Miller Co., and Charles E. Waldron, Niagara Mohawk Power (non-residential).

Responsible for the success of this conference were C. E. Waldron, the Society's northeast-regional vice president; Robert Chase, conference chairman; T. Ake, program and papers; C. Harper and B. J. Teraila, properties; R. E. Ballard, publicity; H. R. Young, finance; E. R. Cole, entertainment; L. A. Senofonte, reception and registration, plus the five local chairmen of the participating sections and chapters: R. D. Babcock (Connecticut); J. R Hartman (eastern New York); W. L. Ball (New England); H. A. Anderson (New York); and John French (Yankee). Moderators for the four technical sessions were Messrs. French, Ball, Hartman and John W. Hamilton, chairman-elect of the New York Section.

Long Island Utility Upgrades Service Requirements

The Patchogue Electric Light Co. of Patchogue, N. Y., put new residential service requirements into effect on April 1, 1958. This Long Island power company, which since 1946 has required 3-wire services on its lines with a minimum of three No. 4 or two No. 4 and one No. 6 AWG conductors, has made mandatory for all residential occupancies (regardless of size) the following minimum specifications:

(1) 100-amp capacity, with three No. 2 or two No. 2 and one No. 4 RH AWG conductors.

(2) 100-amp main disconnect, which must disconnect *all* conductors except the grounded neutral.

(3) Specific provision for a range disconnect and protection on the load side of the main disconnect.

(4) Provision for eight single-pole branch circuit protective devices, in addition to necessary range circuit protection. Where breaker panels are used, a panel is acceptable which has a 100-amp breaker and 12 single-pole breaker positions. Split-bus and parallel-connected panels are not approved.

These specifications were put into effect after an open meeting of power company officials and local electrical contractors, at which the contractors voted overwhelming approval of the proposal.

In a summary of the new requirements sent to builders, contractors and inspectors, the utility concluded: "These homes will be safer and more convenient homes, have greater initial and resale value, and allow their owners to enjoy more of the newest appliances for better living."

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No knob to turn. No toggle to flip. Now, there's a switch designed for today's *push-button living*. It's "B" Touchette, the touch switch with feather-light operation. Not only that . . . but when you specify Touchette for new construction or remodeling jobs, you have easy installation, as well. Touchette measures just *one inch* in depth . . . allows for quick, simple installation . . . even in boxes where several wires enter.

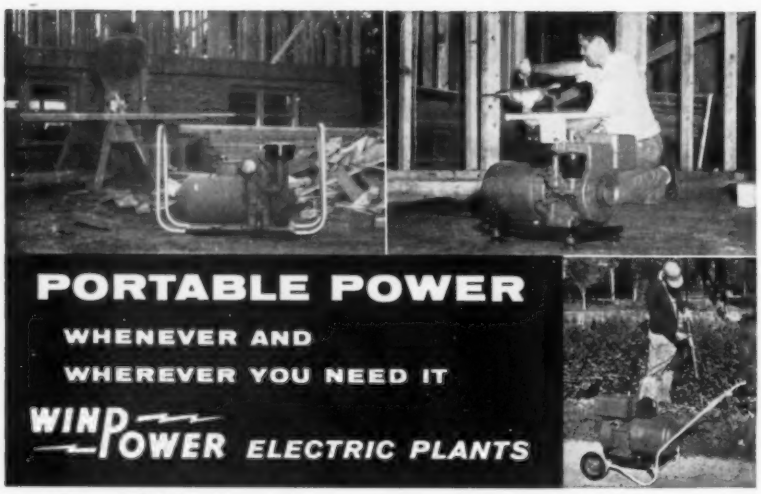
Touchette needs no special wiring . . . fits standard outlet boxes and toggle wall plates and operates on full line voltage. Rated 15A—120—277V, it withstands motor loads up to 80% of rated capacity.

All these features . . . and "B" Touchette is the least expensive touch switch on the market!

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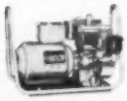
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- *Simplifies* time switch selection problem.
- *Assures* full scale quality at competitive price.

Badger Model

Heavy-duty 50 amp. switch for dependable control of substantial loads. Copper-to-copper contacts with pressure type terminals. Brass gears run with steel pinions. Vernier time set. Indoor or outdoor cabinets. Optional features include omitting device, extra trippers and one-hour dial.

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Versatile 30 amp. switch available in seven standard types for a variety of control applications. Silver contacts. Brass gears run with steel pinions. One piece, deep drawn, steel cabinet with hinged cover. Combination ½ and ¾-inch knockouts. One- or two-circuit control. Three types available with astronomic dial.

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Budget-priced 20 amp. switch with all of the convenience features of the higher priced models. Silver contacts. Precision stamped gear train. One-piece deep drawn steel cabinet with hinged cover. Combination ½- and ¾-inch knockouts. Vernier time set.

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RELIANCE AUTOMATIC LIGHTING CO.
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RELIANCE TIME SWITCHES



FIRST PRIZE AWARD was recently presented to J. D. Harrison (left), Bennie Electric, Ltd., Hamilton, Ont. (Canada), electrical contractors, for his entry covering the outstanding lighting installation in the West End Library of that city in the 1957 International Lighting Competition. Berlon C. Cooper, Eastern editor, "Electrical Construction and Maintenance," and contest Chairman, presented the award. A Certified Lighting certificate was also presented to Miss Freda F. Waldon, chief librarian, indicating that the library lighting conforms to certification standards of the National Lighting Bureau.

NISA News

Western Michigan Chapter meets on May 26 at Federal Square Grill in Grand Rapids, Mich.

• • • •

Rusch Electric Co. of Waukesha, Wis., joined the Wisconsin Chapter of NISA on March 18 at the group's monthly meeting. Richard Wareham, the president of Special Electric Co., Milwaukee, Wis., distributors of the new water-reducible varnish, was guest speaker.

• • • •

Walter Leirer of Queens Electric Motor Corp., Jamaica, N. Y., was elected president of the New York Metropolitan Chapter.

• • • •

Foremen and owners of motor shops from the southeastern states met in Charlotte, N. C., April 4-5, for the Southeastern Chapter's annual Foremen's Meeting.

• • • •

Michael J. Kovall was re-elected president of Los Angeles Chapter. He is owner of Kovall Electric Works, Hollywood, Calif.

• • • •

Stan Stutsman of Squier Electric Co., Harbor Springs, Mich. is editor of the Western Michigan Chapter Newsletter.

Kornfeld-Thorp Electric Co., Kansas City, Mo., celebrated its 20th anniversary on May 5. The firm was started in 1938 in the basement of Roy Kornfeld's home at 4436 Flora Ave., and a year later a building at 3310 Gillham Plaza was purchased. The shop moved to 2700 McGee Trafficway, its present location, in 1949. Orvill Thorp is the other principal in the firm.

• • • •

The Spring meeting of Rocky Mountain Chapter was held March 21-22 in Denver at the Hotel Continental. Guest speakers included NISA president Alfred Elson, Jr.; George Larsen of Larsen-Hogue Electric Co., Los Angeles, Calif.; Thomas M. Paul of Paul Electric Co., Sioux City, Iowa, a regional director of the association; and Joseph M. Harrington, the executive vice-president of NISA.

• • • •

Rocky Mountain Chapter will hold its next meeting in Aspen, Colo. on September 19-20.

• • • •

Bill Saunders of Lenawee Electric Co., Adrian, Mich., was elected president of Great Lakes Chapter at a meeting in Detroit on April 21. Mace Green is vice-president; Charles E. Smith, secretary; Charles Howard, treasurer; and Red Waterson and Jim Spaulding, directors.

• • • •

James A. Covert of Covert Electric Machinery, Joplin, Mo., was elected president of Heart of America Chapter at a meeting in Kansas City on March 14-15. A. E. Johnson of Electric Motor Service, Great Bend, Kansas, was chosen vice-president; and William N. Pickett of Electric Motor Supply, Joplin, Mo., was elected secretary-treasurer.

• • • •

NISA's Midwestern Chapter met March 14-15 in Sioux City, Iowa, at Hotel Sheraton-Martin. Sixty-eight registered for the meeting which featured speeches by Frank Ross, NISA national treasurer, Ross Electric Motor Shop, Fairmont, Minn.; Richard Wareham of Special Electric Co., Milwaukee, Wis.; and Thomas Paul, NISA director from Sioux City.

Max Moore of Kearney, Neb., was elected president of the chapter. Vice-president is Mike Zack of Mason City, Iowa, a former national president; secretary-treasurer is Nick Tamasi of Des Moines, Iowa.

• • • •

Clark Mesler of Consolidated Edison Co., Grand Rapids, Mich., was re-elected president of Western

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Easy to install . . . requires shallow hole . . . fixture can be removed and replaced without loosening anchor . . . a few hammer blows set anchor firmly . . . conical-shape nut expands lead sleeve to provide strong holding power . . . widely used by electricians, plumbers, carpenters, ornamental iron workers, maintenance men, awning and sign men and other tradesmen.

Cutaway drawings show how setting tool expands lead sleeve around conical nut.

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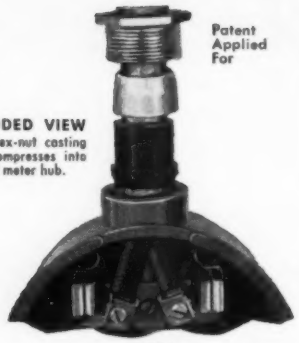
service entrance

connectors

THIS exclusive M&W fitting introduces a new high in simplified installation. The hex-nut casting compresses the neoprene gland *directly into the hub* of the meter socket. This permits a faster, easier installation. The conical metal sleeve gives ample take-up around the cable, prevents cable-twisting, and makes a more adequate seal with neater appearance.

New HNS-23 M&W Connectors save time, cut costs, provide ONE connector to handle ALL sizes of 100-amp rated cable. Write today for sample fitting, prices and details.

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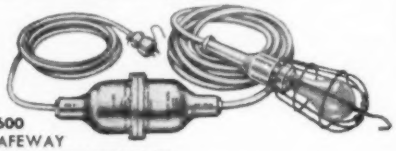
"Safety Yellow" NEŌTEX is an oil-proof synthetic compound that . . . Reduces Accidents . . . Reduces Pilferage . . . Promotes Good Housekeeping . . . and Guarantees WOODHEAD products of Superior Quality.



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LIGHTING AWARDS were made to two Wisconsin electrical contractors recently at a luncheon meeting of the Milwaukee Electric League. They were: John C. Staff, Jr. (left), Milwaukee, who won one third prize and two honorable mention awards, and John A. Schneider, Langstadt's, Inc., Appleton, who won an honorable mention award. August Eckel, (right), middle-West editor of "Electrical Construction and Maintenance," presented the awards on behalf of the contest sponsors.

Michigan Chapter at a recent meeting. Other officers are: Vice-president, Paul Bogdan, Clement Electric, Grand Rapids; secretary-treasurer, Burr Hinklet, Kirkhof Electric, Grand Rapids.

• • • •

The plant of Milton H. Eisenhardt in Pennsauken, N. J., was the site of the April 9 meeting of Quaker City Chapter.

• • • •

Greater Cleveland Chapter met on March 17 at Hotel Manger for general discussions under the leadership of Sam Spector.

• • • •

The fall meeting of Southeastern Chapter will be held on October 2-4 at Old Point Comfort, Va.

• • • •

August Verdurmen of Skeen Electric Works, was elected president of Oregon Chapter at a meeting held on February 27. Curtis Johnson of Electrical Construction Co. was named vice-president; and H. E. Perkins, C. E. Riggs, Inc., secretary.

• • • •

October 10 is the date for Northwest Regional Conference in Portland, Ore., a meeting of three chapters, Oregon, Puget Sound and British Columbia.

• • • •

Robert Campbell of Krauth-Campbell Electric, was elected president of Louisville Chapter at a meeting held on March 11. Richard Nalley of William C. Krauth Co. was chosen vice-president; William Cecil of Owen Gollar Electric Co. was named secretary and Bernad Smith of Marine Electric, treasurer.

DATES AHEAD

International Association of Electrical Inspectors— Virginia Chapter, Ingleside Inn, Staunton, Va., May 12-13; **Western Section,** Sheraton-Cadillac Hotel, Detroit, Mich., September 7-10; **Northwestern Section,** Billings, Mont., Sept. 15-17; **Southwestern Section,** Southern California, September 22-24; **Canadian Section,** Montreal, Quebec, Canada, October 3-4; **Eastern Section,** October 13-15; **Southern Section,** Miami, Fla., October 20-22.

Illuminating Engineering Society— South Pacific Conference, El Cortez Hotel San Diego, Calif., May 12-13; **Pacific Northwest** Conference, Multnomah Hotel, Portland, Ore., May 22-24; and **Great Lakes** Conference, Sheraton Hotel, Rochester, N. Y., June 23-24.

National Industrial Service Assn.—25th "Jubilee Celebration," Hotel Roosevelt, New Orleans, La., May 11-14.

National Fire Protection Assn.—Annual meeting, Palmer House, Chicago, Ill., May 19-23.

National Association of Electrical Distributors—50th annual convention, Civic Auditorium, San Francisco, Calif., June 9-13.

Edison Electric Institute — Annual convention, Convention Hall, Boston, Mass., June 9-12.

New York State Assn. of Electrical Contractors & Dealers, Inc.—Annual convention, Whiteface Inn, Lake Placid, N. Y., June 29-July 4.

Illuminating Engineering Society — National Technical Conference, Toronto, Canada, August 17-22.

International Association of Electrical Leagues—Annual Conference, Washington, D. C., October 1-3.

National Electronics Conference, Inc. —Hotel Sherman, Chicago, Ill., October 13-15.

National Electrical Manufacturers Assn.—Annual conference, Hotel Traymore, Atlantic City, N. J., November 10-14.

National Electrical Contractors Assn., —Annual convention and National Electrical Exposition, Adolphus Hotel, Dallas, Texas, November 16-21.



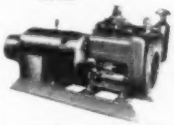
AT NISA Northeastern Conference in Hartford, Conn., from left: Dave Kelly and George Borthig Jr. (right) of George Borthig Co., East Rutherford, N. J. with Thomas F. Coughlan of Huse-Liberty Mica Co., Peabody, Mass. and Max Skobel of Industrial Accessories, Inc., Matawan, N. J.

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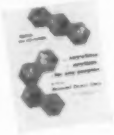
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Compact, hand-carried 1500-watt Universal.



Modern-design, 10 kw., air-cooled, gasoline-powered Universal.



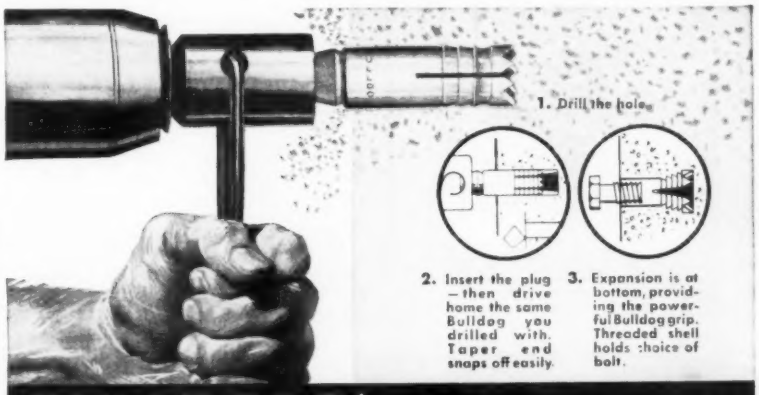
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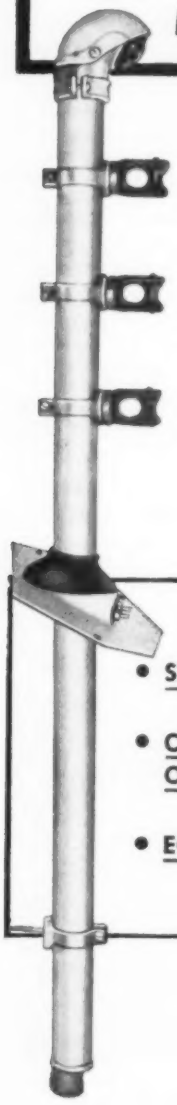
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- **POSITIVE HOLDING POWER**—¼" size, holds up to 3150 lbs.... ⅞" size, 19,620 lbs.!
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Headquarters Announcements

Howard Industries, Inc., of Racine, Wis., has purchased the physical assets, business and name of the Loyd Scruggs Co., of Festus, Mo.

Shallcross Mfg. Co. is relocating its entire operation from Collingdale, Pa., to Selma, N. C.

Sola Electric Co., Chicago, Ill., has been acquired by **Basic Products Corp.**, Milwaukee, Wis., and will be operated as a division of Basic Products.

Lighting Dynamics, Inc., is the new name of **Ruby Lighting**, with plants in Whittier, Calif., and Dallas, Tex.

Pittsburgh Reflector Co., Pittsburgh, Pa.—Charles S. Kernaghan, general sales manager.

Lonergan Coolerator Div., McGraw-Edison Co., Albion, Mich.—M. F. Beisber, president.

Termite Drills, Inc., Pasadena, Calif.—William C. Kinard, president.

Lima Electric Motor Co., Inc., Lima, Ohio—Patrick F. Dwyer and Burt F. Wyandt, vice presidents.

General Electric Co., Plainville, Conn.—Robert W. Dorsey, manager, advertising and sales promotion, Circuit Protective Devices Dept.

Tork Time Controls, Inc., Mount Vernon, N. Y.—Harry G. Anschuetz, member of the board of directors.

Sylvania Electric Products Inc., Salem, Mass.—James R. Steel, advertising manager of Sylvania Lighting Products.

United States Steel Corp., Cleveland, Ohio—Edward A. Murray, assistant vice president of sales, American Steel & Wire Div.

Anaconda Wire & Cable Co., Hastings-on-Hudson, N. Y.—Walter J. Plate, manager of accessories division.

Pyramid Instrument Corp., Lynbrook, N. Y.—Milton Wisoff, executive sales manager.

Union Metal Mfg. Co., Canton, Ohio—L. F. Heckman, general sales manager.

Thomas Industries Inc., Louisville, Ky.—Robert D. Burns, Sr., vice president and chairman of the finance committee.

I-T-E Circuit Breaker Co., Philadelphia, Pa.—Ernie A. Schmidt, commercial vice president, in addi-

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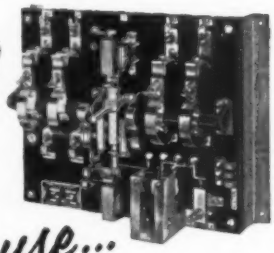
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tion to duties as midwest regional sales manager.

Sola Electric Co., Chicago, Ill.—Ralph H. Schlote, manager, specialty transformer sales.

Dayton Rubber Co., Dayton, Ohio—Robert C. Burson, assistant general sales manager, Mechanical Goods Div.

Frankelite Co., Cleveland, Ohio—Allan Schwartz, industrial sales manager.

Steel City Electric Co., Pittsburgh, Pa.—W. H. Satterfield, general sales manager.

Paragon Electric Co., Two Rivers, Wis.—J. R. Kenny, treasurer, new member of the board of directors. New vice presidents: G. J. Platt, J. R. Kenny, R. W. Eldred, and J. J. Everard.

Regional Appointments

NEW ENGLAND

Markel Electric Products, Inc., and LaSalle Products, Inc.: D & F Sales Co., representatives in all of New England except parts of Connecticut.

Frink Corp.: George D. Montgomery, representative in Massachusetts, Rhode Island, Vermont, New Hampshire and Maine.

John C. Virden Co.: Thomas L. Leslie, Jr., representative in New England states except Connecticut, headquarters in Boston.

MIDDLE ATLANTIC

Silvray Lighting, Inc.: Jules Levenstein, New York District sales manager, office in New York.

Ward Leonard Electric Co.: New Jersey branch office has moved to Bloomfield, N. J., managed by Chester J. Penza.

Edwards Company: Robert J. Doherty, district manager for western Pennsylvania and northern West Virginia.

SOUTH ATLANTIC

Diamond Expansion Bolt Co., Inc.: J. T. Cobb, manager of new branch office and warehouse in Washington, D. C.

EAST CENTRAL

Accurate Mfg. Co.: C. J. Sampson & Son, St. Louis, Mo., agent in eastern Missouri and southern Illinois.

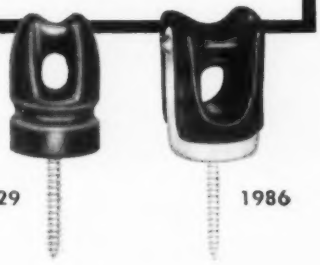
Thomas Industries Inc.: James F. Best, Indianapolis, Ind., sales representative for the Moe Light Div.

Frink Corp.: Robert D. Sweeney Associates, representative in Michigan, office in Grosse Ile, Mich.

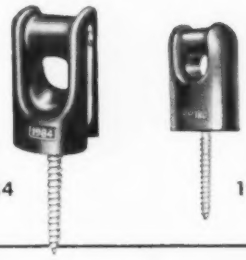
Allis-Chalmers Mfg. Co.: Carl R. Hall, manager of district sales

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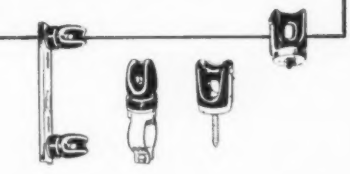
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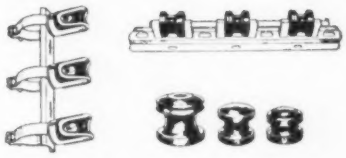


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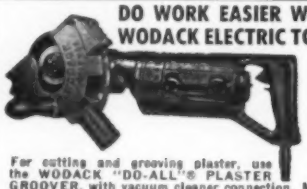
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office in Rockford, Ill.; Richard L. McDermott, manager of General Industrial Sales section of Cincinnati district office.

Okonite Company: Elbridge H. McNeill, Chicago, regional sales manager of new Mid-West sales region.

Wolverine Tube, Div. of Calumet & Hecla, Inc.: Charles A. Johnson, sales representative in Chicago metropolitan area; Melvin A. Jackson, sales representative in Indiana and Ohio area, office in Dayton, Ohio.

Pittsburgh Reflector Co.: Paul Angrick, sales representative for Indianapolis, Ind., sales territory.

WEST CENTRAL

Frink Corp.: C. J. Sampson and Son, St. Louis, representative in state of Missouri.

Kuhlman Electric Co., Birmingham, Mich.: Gakle Sales, representative in Minnesota.

Allis-Chalmers Mfg. Co.: A. P. Bowman, manager of Milwaukee district office; James I. Onarheim, manager of utility sales, Milwaukee district.

John C. Virden Co., sales representative in Kansas and Missouri, except St. Louis area.

WEST

Frink Corp.: Barney H. Hartley, Phoenix, representative in Arizona.

Ward Leonard Electric Co.: Dallas representative P. J. Scanlon Co. has opened new office in Houston, Tex., serving southern Texas area.

Kuhlman Electric Co.: Hollis R. Johnson, representative for West Texas and New Mexico.

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LOcust 8-4330
H. BOZARTH
R. EDSALL

SAN FRANCISCO, 4
68 Post St.
DOuglas 2-4600
R. ALCORN

Advertising In This Issue

• Accurate Mfg. Co. 6
Acme Steel Company 68
• Adalet Mfg. Co., The 266
Adam Electric Co., Frank 194, 195
• Advance Transformer Co. 171, 172
Allen-Bradley Co. 137, 138
Allis-Chalmers Mfg. Co. ..168, 296, 301
• All-Steel Equipment, Inc. 29
Aluminum Co. of America 53, 178
• American Brass Co., The American Metal Hose Branch 216, 217
• American Louver Co. 288
• American Steel & Wire Div. of U. S. Steel Corp. 184, 185
American Telephone & Telegraph Co. 14
AMP Incorporated 69
Amprobe, A Div. of Pyramid Inst. Corp. 283
Anaconda Wire & Cable Co. 30, 31
Appleton Electric Co. 2
• Arro Expansion Bolt Co. 327
• Arrolet Corp 272
• Arrow-Hart & Hegeman Elec. Co., The 278, 279
Auth Electric Co., Inc. 20
Automatic Switch Co. 189, 190

• Bell Electric Co. 286, 287
Bell Telephone System 14
• Berko Electric Mfg. Corp. 266
Biddle Co., James G. 300
Black & Decker Mfg. Co. 192, 193, 268
Blackhawk Industries 270
• Boston Woven Hose & Rubber Co. 56
• Briegel Method Tool Co. 70
Brook Motor Corp. 270
Bryant Electric Co., The 54, 55
Buffalo Forge Co. 268
BullDog Electric Products Co. 179, 180, 181, 182
Burndy Corp. 141
Bussmann Mfg. Co. 12, 13

Calvert Co., The 282
Century Electric Co. 241
Certified Ballast Mfgrs. 18
Champion Lamp Works 276
Circle Wire & Cable a Subsidiary of Cerro de Pasco Corp. 166, 167
Clark Controller Co., The 170
Columbia Cable & Electric Corp. .. 39
Conduit Nipple Mfg. Co. 284
• Continental Electric Equipment Co. 197
• Cope Div. T. J., Rome Cable Corp. 320
Corning Glass Works 183
• Crescent Insulated Wire & Cable Co. 67
• Crouse-Hinds Fourth Cover, 186, 187
• Curtis Lighting, Inc. 32
Cutler-Hammer, Inc. 26

Day-Brite Lighting, Inc. 210, 211
Delta Star Electric Div. H. K. Porter Company, Inc. 303
Diamond Wire & Cable Co. 231
Dodge Corp., F. W. 198
• Dossert Mfg. Corp. 49
Dutch Brand Div., Johns-Manville 11

Eagle Electric Mfg., Co., Inc. 226
• Economy Fuse & Mfg. Co. 58
• Edwards Co., Inc. 222, 223
Efficiency Electric & Mfg. Co. 287
Electric Controller & Mfg. Co. a Div. of Square D Co. 1
Electric Distribution Products, Inc. 334
• Electric Tube Products 57
• Electro Compound Co. 287
• Electri-Flex Co. 228
Erico Products, Inc. 229
Exide Industrial Div., The Electric Storage Battery Co. 245

Fasco Industries, Inc. 51
Federal Lighting Corp. 293
• Feedrail Corp. 281
• Fullman Mfg. Co. 289
Furnas Electric Co. 294

• Garden City Plating & Mfg. Co. .. 188
• Gedney Electric Co. 27
• General Cable Corp. 21
• General Electric Co.
• Apparatus Sales Div. 40, 41, 42, 43, 44, 45
Construction Materials Div. ..22, 23, 242, 243
Globe Co., The 230
• Graybar Electric Co., Inc. 72
• Greenlee Tool Co. 234
Griphoist, Inc. 272
• Guth Co., Edwin F., The Second Cover, 37

Heinemann Electric Co. 236
• Helwig Co. 284
• Henderson-Hazel Corp. 308
• Hevi-Duty Electric Co. 272
Hill Transformer Co., Inc. 277
Hoffman Eng. Corp. 280
• Holophane Company, Inc. 196
Holub Industries, Inc. 269
• Hose-McCann Telephone Co., Inc. 289
• Hubbell Inc., Harvey 8
• Huenefeld Co., The 240
• Husky Products, Inc. 221

• Ideal Industries, Inc. 209, 238
• Ideal-Simplet Fittings, Inc. 321
Ilg Electric Ventilating Co. 169
Insul-8 Corp. 332
• International Register Co. 248
• I-T-E Circuit Breaker Co.
• R & IE Equipment Div. 177
Small Air Circuit Breaker Div. 174, 175
• Switchgear Div. 173
Transformer & Rectifier Div. 176

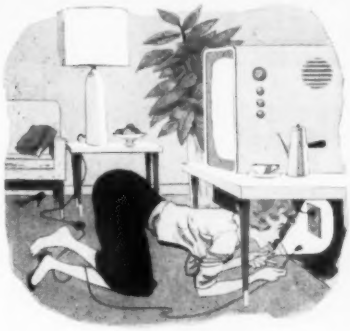
Jenkins Brothers 65
• Johns-Manville 64

• Kaiser Aluminum & Chemical Sales Inc. 219
Kalamazoo Tank & Silo Co. 289
Kees Mfg. Co., F. D. 280
Kellogg Switchboard and Supply Co. 282
Keystone Mfg. Co. 227
• Killark Electric Mfg. Co. 201
Kirkland Co., H. R., The 284
Koeneman Co., R. A. 332
Kuhlman Electric Co. 306

Land-Air, Inc. 282
• Leviton Mfg. Co. 285
• Lidseen of North Carolina, Inc. .. 271
Lightolier 249
Litecontrol Corp. 52

M & W Electric Mfg. Co., Inc., The 328
• Marcus Transformer Co., Inc. 284
Markstone Mfg. Co. 271
McGill Mfg. Co., Inc. 38
McPhilben Ltg. Co. 200
Metalcraft Products Co., Inc. 244
Micro Switch a Div. of Minneapolis-Honeywell Regulator Co. 206
Miller Co., The 215

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Hartford 10, Connecticut

• Minerallac Electric Co. 331
Minneapolis-Honeywell 253
Mitchell Lighting Co. div. of Compco Co. 307
Mosley Electronics, Inc. 291
• Multi Electric Mfg. Inc. 252

Narragansett Wire Co. 63
National Electric Products...212, 213
National Wiring Bureau.....9, 10
• National Price Service..... 308
Nye Tool Co. 292

• Okonite Co., The 310
• Onan & Sons, Inc. D. W. 269
Orangeburg Mfg. Co., Inc. 46
• O. Z. Electrical Mfg. Co., Inc..246, 247

Paranite Wire & Cable Div., Essex Wire Corp. 214
Pass & Seymour, Inc. 47
• Phelps Dodge Copper Products Corp. 202, 203
Pittsburgh Reflector Co. 218
Pittsburgh Standard Conduit Co.. 59
• PLM Products, Inc. 292
Plymouth Rubber Co., Inc. 235
• Polis Mfg. Co., J. D. 329
• Porcelain Products, Inc.....330, 331
• Precision Transformer Corp. 317
Pyle-National Co., The 15

Quaker Rubber Div., H. K. Porter Company, Inc. 302

Radio Corp of America 255
• Ramset Fastening Inc. 254
Reading Body Works, Inc. 256
• Reliance Automatic Lighting Co.. 326
Remeon, A Div. of Pyramid Instrument Corp. 274, 275
• Remington Arms Co. Inc. 259
Revere Electric Mfg. Co....304, 313
Reynolds Metals Co. 237
Ridge Tool Co., The 273
• RLM Standards Institute, Inc.. 224
Rockbestos Products Corp. 257
• Rodale Mfg. Co., Inc. 325
Rohm & Haas Co. 62
Rome Cable Corp. 261, 263
Royal Electric Corp. 258
Ruby-Philite Corp. 265
• Russell & Stoll, Inc. 145

• S & C Electric Co. 309
Sangamo Electric Co. 260
• Sierra Electric Corp. 66
• Simplex Wire & Cable Co. 4
Slater Electric & Mfg. Co., Inc.. 308
Smithcraft Lighting 267
• Sola Electric Co. 220
• Sorgel Electric Co. 48
• Sperti Faraday, Inc. 315

Square D. Co. .....Third Cover
16, 17, 204, 205
• Standard Transformer Co., The.. 262
Steelduct Co., The 143
Star Expansion 277
Sticht Co., Inc., Herman H. 331
Sunbeam Lighting Co. 199
Sylvania Electric Products, Inc.. 60
61, 250, 251

Tevco Insulated Wire 314
• Thiel Tool & Engineering Co., Inc. 292
• Thomas & Betts Co., The 225
Thomas Industries Inc. 191
Thompson Electric Co., The 264
• Triangle Conduit & Cable Co., Inc. 33
34, 35, 36

United States Rubber Co. 19
Universal Motor Co. 329
Up-Right Scaffolds 50
Uptegraff Mfg. Co., R. E....232, 233
Utica Drop Forge & Tool Div. Kelsey-Hayes Co. 312
Utility Transformer and Equipment Co. 330
U. S. Expansion Bolt Co. 280

• Velocity Power Tool Co. 322
Virden Co., John C. 24, 25

• Wadsworth Elec. Mfg. Co., Inc., The 292
• Wagner Electric Corp..207, 208, 318
• Westinghouse Electric Corp. ....
Lamp Div. 152
Lighting Div. 164, 165
• Pittsburgh 147, 148, 149, 150
151, 153, 154, 155, 156, 157, 158
159, 160, 161, 162, 163
Where to Buy. 332
Whitney Blake Co. 290
• Wiegand Co., Edwin L. 239
Wiley Inc., R. & W. 314
Winpower Mfg. Co. 326
Wiremold Co., The 333
• Wodack Electric Tool Corp. 332
Woodhead Co., Daniel 328

• Youngstown Sheet & Tube Co., The 28

• Zenith Electric Co. 330

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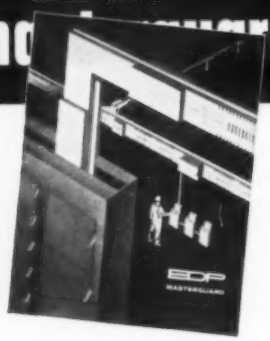
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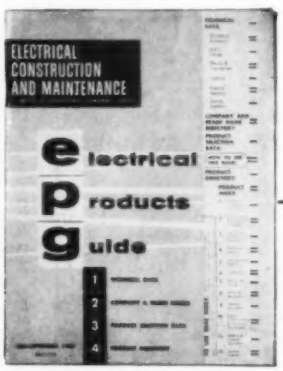
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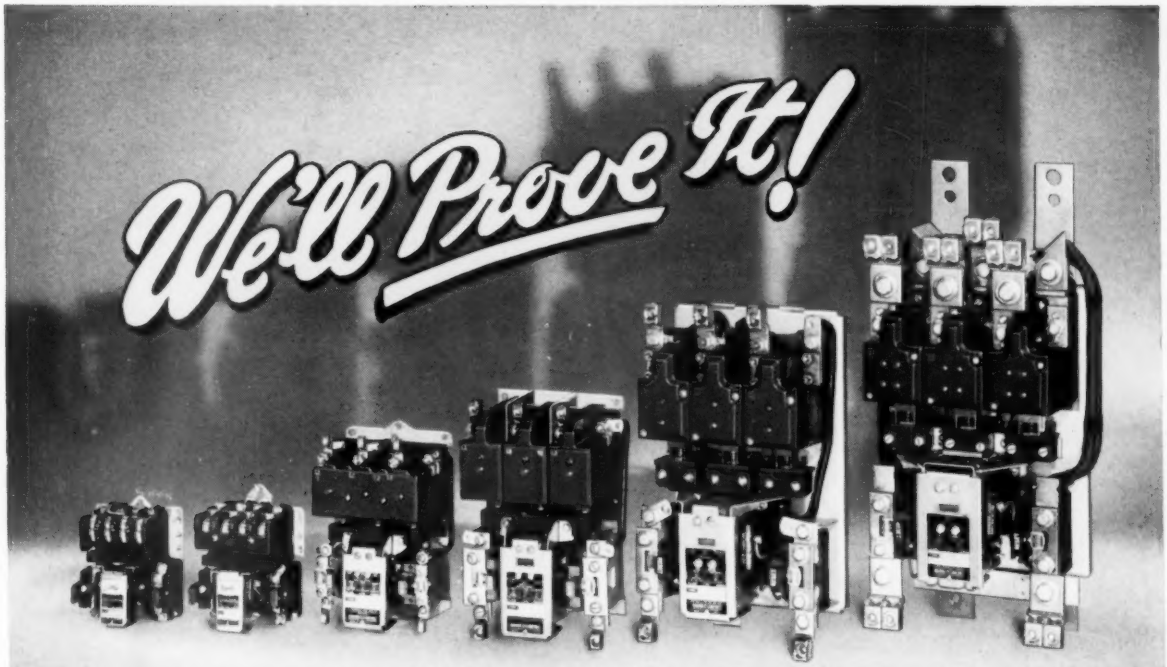
EDP

Electric Distribution Products, Inc.
2200 31st Street, Allentown, Penna.



• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE

For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.



Square D Vertical Action Magnetic Starters Sizes 0, 1, 2, 3, 4 and 5

ONLY SQUARE D GIVES YOU ALL 5

1 *QUICK* INSTALLATION!

No groping or fumbling. Square D gives you lots of wiring space, plenty of knockouts, handy and clearly marked pressure wire connectors.

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4 *EASY* INSPECTION and MAINTENANCE!

No starter is "maintenance-free." But Square D makes the job easy. Inspection is a breeze. You don't have to remove wiring for contact replacement or take the starter out of the enclosure to change coils.

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Please send me your new bulletin with detailed proof that Square D offers me my best starter investment.

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SQUARE D COMPANY





New CROUSE-HINDS EXPLOSION-PROOF MERCURY VAPOR LIGHTING FIXTURES

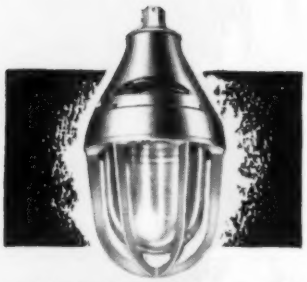
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- *where long burning hours without interruption are involved, month in, month out*
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- *where maximum lighting output calls for maximum economy in power consumption*

The longer life of mercury vapor lamps is well established: 7000 hours, *vs.* 1000 hours for incandescents. Light output is 2.5 times greater; 55 lumens/watt, *vs.* 22 lumens/watt for incandescents.

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250 Watt— National Electrical Code: Class I, Groups C & D

400 Watt— Class I, Group D

CROUSE HINDS

MAIN OFFICE AND FACTORY: SYRACUSE, NEW YORK

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